Consultation on Species Listing Eligibility and Conservation Actions

Pristis pristis (largetooth sawfish)

You are invited to provide your views and supporting reasons related to:

1) the eligibility of *Pristis pristis* (largetooth sawfish) for inclusion on the EPBC Act threatened species list in the Endangered category; and

2) the proposed conservation actions for the largetooth sawfish.

The purpose of this consultation document is to elicit additional information to better understand the status of the species and help inform conservation actions and further planning. As such, the draft assessment should be considered to be **tentative** as it may change following responses to this consultation process.

Evidence provided by experts, stakeholders and the general public are welcome. Responses can be provided by any interested person.

Anyone may nominate a native species, ecological community or threatening process for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or for a transfer of an item already on the list to a new listing category. The Threatened Species Scientific Committee (the Committee) undertakes the assessment of species to determine eligibility for inclusion in the list of threatened species and provides its recommendation to the Australian Government Minister for the Environment.

Responses are to be provided in writing by email to: species.consultation@dcceew.gov.au. Please include "*Pristis pristis*" in Subject field.

The Director
Shark and Ray Conservation
International Environment, Reef and Ocean Division
Department of Climate Change, Energy, the Environment and Water
(Attention: species.consultation@dcceew.gov.au)
GPO Box 3090
Canberra ACT 2601

Responses are required to be submitted by 13 January 2025.

Contents of this information package	Page

General background information about listing threatened species

The Australian Government helps protect species at risk of extinction by listing them as threatened under Part 13 of the EPBC Act. Once listed under the EPBC Act, the species becomes a Matter of National Environmental Significance (MNES) and must be protected from significant impacts through the assessment and approval provisions of the EPBC Act. More information about threatened species is available on the department's website at: https://www.dcceew.gov.au/environment/biodiversity/threatened

Public nominations to list threatened species under the EPBC Act are received annually by the department. In order to determine if a species is eligible for listing as threatened under the EPBC Act, the Threatened Species Scientific Committee (the Committee) undertakes a rigorous scientific assessment of its status to determine if the species is eligible for listing against a set of criteria. These criteria are available on the Department's website at: Guidelines for assessing the conservation status of native species according to the Environment Protection and Biodiversity Conservation Act 1999 and Environment Protection and Biodiversity Conservation Regulations 2000 (dcceew.gov.au)

As part of the assessment process, the Committee consults with the public and stakeholders to obtain specific details about the species, as well as advice on what conservation actions might be appropriate. Information provided through the consultation process is considered by the Committee in its assessment. The Committee provides its advice on the assessment (together with comments received) to the Minister regarding the eligibility of the species for listing under a particular category and what conservation actions might be appropriate. The Minister decides to add, or not to add, the species to the list of threatened species under the EPBC Act. More detailed information about the listing process is at: Nominating a species, ecological community or key threatening process under the EPBC Act - DCCEEW

To promote the recovery of listed threatened species and ecological communities, conservation advices and where required, recovery plans are made or adopted in accordance with Part 13 of the EPBC Act. Conservation advices provide guidance at the time of listing on known threats and priority recovery actions that can be undertaken at a local and regional level. Recovery plans describe key threats and identify specific recovery actions that can be undertaken to enable recovery activities to occur within a planned and logical national framework. Information about recovery plans is available on the department's website at: https://www.dcceew.gov./environment/biodiversity/threatened/recovery-plans

Privacy notice

The Department will collect, use, store and disclose the personal information you provide in a manner consistent with the Department's obligations under the Privacy Act 1988 (Cmth) and the Department's Privacy Policy. Personal information means information or an opinion about an identified individual, or an individual who is reasonably identifiable.

Any personal information that you provide within, or in addition to, your comments in the threatened species assessment process may be used by the Department for the purposes of its functions relating to threatened species assessments, including contacting you if we have any questions about your comments in the future.

Further, the Commonwealth, State and Territory governments have agreed to share threatened species assessment documentation (including comments) to ensure that all States and Territories have access to the same documentation when making a decision on the status of a potentially threatened species. This is also known as the 'Common Assessment Method' (CAM). As a result, any personal information that you have provided in connection with your comments may be shared between Commonwealth, State or Territory government entities to assist with their assessment processes.

The Department's Privacy Policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent, how respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint. Alternatively, email the department at privacy@dcceew.gov.au. A copy of the Department's Privacy Policy is available at: https://www.dcceew.gov.au/about/commitment/privacy

Information about this consultation process

Responses to this consultation can be provided electronically or in hard copy to the contact addresses provided on Page 1. All responses received will be provided in full to the Committee and then to the Australian Government Minister for the Environment and Water.

In providing comments, please provide references to published data where possible. Should the Committee use the information you provide in formulating its advice, the information will be attributed to you and referenced as a 'personal communication' unless you provide references or otherwise attribute this information (please specify if your organisation requires that this information is attributed to your organisation instead of yourself). The final advice by the Committee will be published on the department's website following the listing decision by the Minister.

Information provided through consultation may be subject to freedom of information legislation and court processes. It is also important to note that under the EPBC Act, the deliberations and recommendations of the Committee are confidential until the Minister has made a final decision on the nomination, unless otherwise determined by the Minister.

CONSULTATION QUESTIONS FOR *Pristis pristis* (largetooth sawfish)

PART 1 – INFORMATION TO ASSIST LISTING ASSESSMENT

1. Do you agree with the current taxonomic position of the Australian Faunal Directory for *Pristis pristis* (largetooth sawfish), as identified in the draft conservation advice?

2. Do you agree with the draft conclusion regarding the species' eligibility for inclusion on the threatened species list?

Biological information

3. Can you provide addition information and references relating to the biology or ecology of the species (e.g., life-history parameters, important habitat, important populations, or population structure)?

Population size

4. Has survey effort for this species been adequate to determine its national distribution and adult population size?

5. Do you accept the estimates of the Key Assessment Parameters in Table 3 (e.g., population size and generation length)?

6. Can you provide any additional data that would inform investigation of population decline during the past or next 10 years or 3 generations, whichever is the longer?

Current Distribution/range/extent of occurrence, area of occupancy

7. Is the distribution as described in the draft conservation advice valid?

8. Has this geographic distribution declined and if so by how much and over what time period?

9. Can you provide an estimate of the current geographic distribution (extent of occurrence or area of occupancy in km^2) of this species?

Threats

10. Do you agree that the threats listed are correct and that their effects on the species are significant?

11. To what degree are the identified threats likely to impact on the species in the future?

12. Can you provide additional or alternative information on threats, past, current or potential that may adversely affect this species at any stage of its life cycle?

13. In seeking to facilitate the recovery of this species, can you provide information on the following:

    a. What individuals or organisations are currently, or need to be, involved in planning to abate threats and any other relevant planning issues?

b. What threats are impacting on different populations, how variable are the threats and what is the relative importance of the different populations?

c. Can you suggest other actions that would help recover the species? Please provide evidence and background information.

d. Can you suggest other research priorities that would improve understanding of the status and recovery of the species?

14. Can you provide information on the cultural significance of the species to First Nations Australians?

The Department of Climate Change, Energy, the Environment and Water recognises that First Nations Australians are the custodians of Indigenous Cultural and Intellectual Property (ICIP). We seek to preserve and protect the rights of First Nations Australians by only collecting, storing or sharing ICIP with free, prior and informed consent. If you intend to provide ICIP, please raise this with us so that we can ensure that the ICIP is appropriately managed.

Australian Government
Department of Climate Change, Energy, the Environment and Water

Conservation Advice for *Pristis pristis* (largetooth sawfish)

This draft document is being released for consultation on the species listing eligibility and conservation actions

The purpose of this consultation document is to elicit additional information to better understand the eligibility of the species for listing and inform conservation actions, further planning and the potential need for a Recovery Plan.

The draft assessment should therefore be considered **tentative** at this stage, as it may change as a result of responses to this consultation process.

Note: Specific consultation questions relating to the draft assessment and preliminary determination have been included in the consultation cover paper for your consideration.

Pristis pristis (largetooth sawfish) © Copyright, Richard Pillans

WARNING: Aboriginal and Torres Strait Islander readers are warned that this document may contain images of deceased persons (photographs in the appendix).

Conservation status

Pristis pristis (largetooth sawfish) is proposed to be transferred from the Vulnerable category to the Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999.*

Pristis pristis was assessed by the Threatened Species Scientific Committee to be eligible for listing as Endangered under Criterion 1. The Committee's assessment is at Attachment A. The Committee's assessment of the species' eligibility against each of the listing criteria is:

- Criterion 1: A2bd: Endangered
- Criterion 2: Ineligible
- Criterion 3: Insufficient data
- Criterion 4: Ineligible
- Criterion 5: Insufficient data

The main factor that makes the species proposed for listing in the Endangered category is a suspected population reduction of > 70% over the last 3 generations (66 years). The Committee's inference is based on, *inter alia*, empirical estimates of decline, population viability analyses (PVA), fisheries-dependent and fisheries-independent catch information, anecdotal information including historic photographic records, standardised catch rates from the Queensland (Qld) Shark Control Program, and evidence of declines and extirpations outside of Australian waters. The main cause of reduction is mortality in commercial fisheries and is ongoing.

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see the Species Profile and Threats Database.

Contents

Species information

In this assessment, the word 'population' is used to refer to the concept of 'subpopulation' in IUCN (2024), in keeping with the terminology used in the EPBC Act and state/territory environmental legislation and general biological language.

Taxonomy

Conventionally accepted as *Pristis pristis* (Linnaeus 1758). This species has previously been referred to as *P. microdon* (common name: freshwater sawfish) in the Indo-West Pacific, *P. perotteti* in the Atlantic, and *P. zephyreus* in the Eastern Pacific, however these taxonomic concepts are synonyms of *P. pristis* (Faria et al. 2013).

Description

The snout of sawfishes (family Pristidae) is greatly extended to form a hard, flattened blade with a row of tooth-like denticles along its edges. The pectoral fins of sawfishes are not fused to the body like in many other ray species. Rather, the body is elongate and subcylindrical with a slightly flattened head projecting well forward of the pectoral fins (eds Last et al. 2016). The largetooth sawfish reaches a maximum size of at least 705 cm total length (TL). Size-at-birth is 72–90 cm TL (Kyne et al. 2021a). The largetooth sawfish has a broad rostrum and the rostral teeth are not noticeably closer to each other at its tip compared to its base. The dorsal side is yellowish to grey and the ventral side is pale grey (eds Last et al. 2016). Largetooth sawfish can be readily distinguished from other sawfishes by (1) its first dorsal fin originating forward of the pelvic fins and (2) an obvious lower lobe of the caudal fin (eds Last et al. 2016).

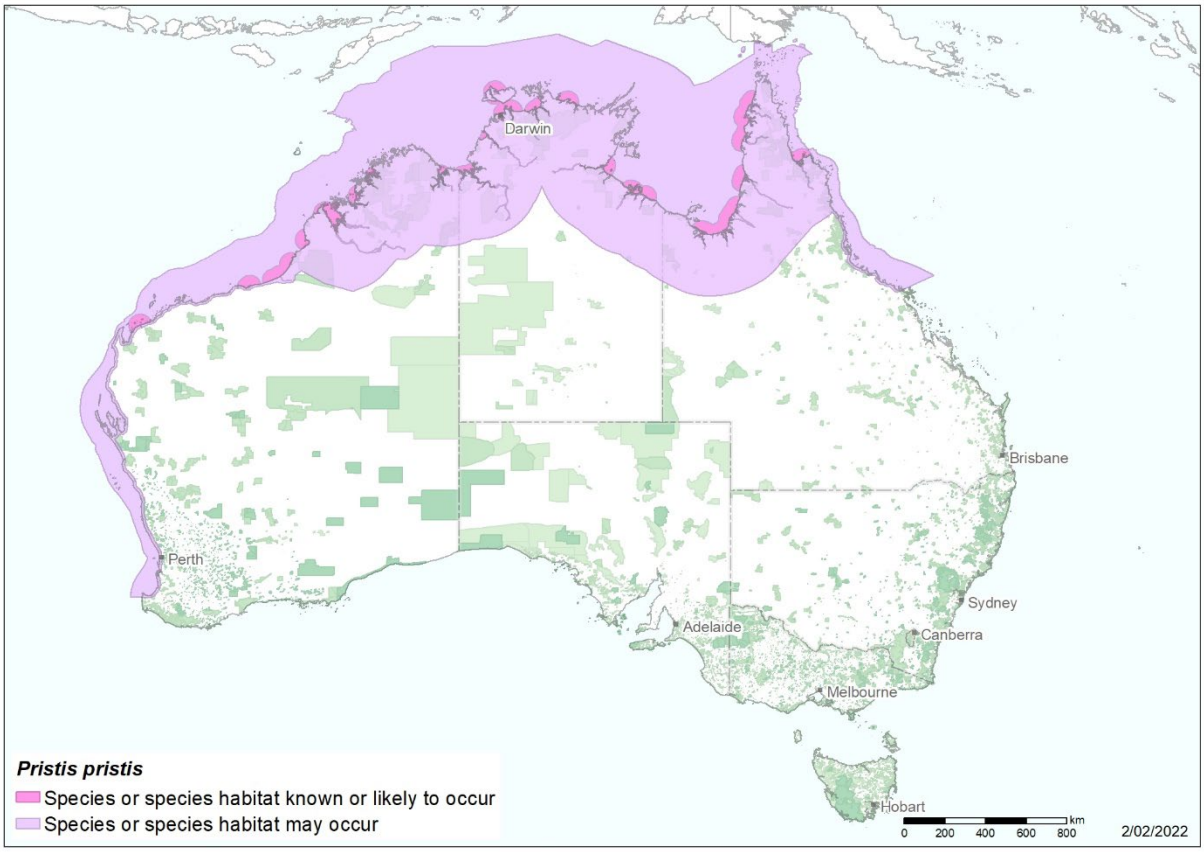
Distribution

The largetooth sawfish was globally widespread in tropical seas, however it is now extirpated across much of its former range (eds Last et al. 2016; Simpfendorfer et al. 2019; Yan et al. 2021). At a global scale, there are four distinct subpopulations: Eastern Atlantic, Western Atlantic, Eastern Pacific and Indo-West Pacific (Faria et al. 2013; Espinoza et al. 2022). Records outside of Australia are now rare, including in places where the species was once described as 'common' or 'abundant' (Kyne et al. 2013; eds Harrison & Dulvy 2014).

Northern Australia appears to be the most significant stronghold for the largetooth sawfish in the Indo-West Pacific region. It is thought that the species now occurs from the Kimberley region (WA), through to the Lakefield National Park in eastern Qld (B. Wueringer unpublished data 2022, cited in Espinoza et al. 2022). There is a single temperate record of this species from the southwest tip of WA (Cape Naturaliste), although this individual is considered to be a vagrant (Chidlow 2007).

Largetooth sawfish are generally restricted to shallow (< 25 m) coastal, estuarine, and fresh waters (Thorburn et al. 2007; Whitty et al. 2009). It is a euryhaline species, with juveniles occurring in estuarine or freshwater areas whereas adults are mostly marine (eds Last et al. 2016). Most information on the species pertains to its early life stages. The movements and distribution of adults are poorly understood (eds Harrison & Dulvy 2014). Tagging studies have documented adult largetooth sawfish moving ~ 1000 km within two months (R Pillans unpublished data 2024).

Map 1 Modelled distribution of largetooth sawfish



Source: Base map Geoscience Australia; species distribution data Species of National Environmental Significance database.
Caveat: The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything contained herein. Due to limited survey effort and information available, *Pristis pristis*, and its habitat, may occur in areas where it has not yet been recorded, and the modelled distribution (Map1) should be considered as indicative only.
Species distribution mapping: The species distribution mapping categories are indicative only and aim to capture (a) the habitat or geographic feature that represents recent observed locations of the species (known to occur) or habitat occurring in close proximity to these locations (likely to occur); and (b) the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (may occur). These presence categories are created using an extensive database of species observations records, national and regional-scale environmental data, environmental modelling techniques and documented scientific research.

Cultural and community significance

The cultural, customary and spiritual significance of species and the ecological communities they form are diverse and varied for First Nations Peoples and their stewardship of Country. This section describes some examples of this significance, but it is not intended to be comprehensive or applicable to, or speak for, First Nations Peoples. Such knowledge may be held by First Nations Peoples who are the custodians of this knowledge and have the rights to decide how this knowledge is shared and used.

Sawfishes have enormous cultural and spiritual importance to some First Nations Peoples. As one example, they have been valued as a source of food and raw materials (McDavitt 2005). Sawfishes are also totem animals for many language groups throughout the species' range. Numerous First Nations groups have emphasised the ecological and cultural role of sawfishes

and the pressing need to protect them (Barber & Woodward 2018). Indigenous Rangers actively participate in research and monitoring of largetooth sawfish and support cultural knowledge transfer (Barber and Woodward 2018; Kyne et al. 2018). Their involvement has been central to the success of research investigating the movement and habitat use of the species.

The EPBC Act does not affect Section 211 of the Native Title Act 1993, which provides that native title holders are not prohibited or restricted from exercising their native title rights (which could include hunting of listed threatened species) for their personal, domestic and non-commercial communal needs. As such, listing of largetooth sawfish as a threatened species under the EPBC Act and the associated recovery plan does not affect native title rights.

Relevant biology and ecology

Life history

The life history of largetooth sawfish remains poorly understood, with some life history parameter estimations being based on small sample sizes (Kyne et al. 2021a, b). All available samples are from the Indo-West Pacific (northern Australia) or the Western Atlantic (Lake Nicaragua-Río San Juan system, Central America) subpopulations (reviewed in Kyne et al. 2021a). The life history of largetooth sawfish is characterised by late age-at-maturity (8–10 years), long lifespan (30–36 years), and low fecundity (litter size range = 1–20 individuals with a mean of 7.3 individuals in Lake Nicaragua). Reproductive periodicity is suspected to be biennial in Lake Nicaragua but annual in Australia (reviewed in Kyne et al. 2021a). These parameters result in a low intrinsic rate of population increase. Estimated rates of population increase for the species (0.03–0.12 yr^{-1}) fall within the 'low' or 'very low' categories of Musick et al. (2000). This categorisation highlights the species' susceptibility to population depletion and that recovery would take many decades (Moreno 2012; reviewed in Kyne et al. 2021a).

Habitat use

In Australian waters, largetooth sawfish are born at the mouths of rivers and in estuaries and then migrate upriver where they spend the first 4–5 years of their life (Thorburn et al., 2004; Last & Stevens 2009). The species has been recorded up to 500 km inland (Giles et al. 2002). Some juveniles, mostly less than 150 cm, are isolated in waterholes for several years, between floods (Last & Stevens 2009).

As they reach maturity, largetooth sawfish move into the marine environment where little is known about their movements and habitat use. In the Fitzroy River, WA, males and females leave the river at approximately 240 and 280 cm, respectively (Thorburn et al. 2007). Data from a variety of surveys and fisheries indicate that individuals probably remain in coastal areas and occasionally up to 100 km from the shore (Giles et al. 2002).

Largetooth sawfish are predominantly benthic, feeding on fishes, crustaceans and molluscs over muddy or sandy seafloors (Peverell 2009; eds Last et al. 2016). The toothed rostrum is used to injure or stun prey (Wueringer et al. 2011, 2012).

Population structure

The Indo-West Pacific subpopulation of largetooth sawfish historically occurred from the Western Indian Ocean to northern Australia but is now patchy across that range (Espinoza et al. 2022). Within the Indo-West Pacific subpopulation, there is likely negligible maternal gene flow between south-east Asia and Australia. If there is genetic exchange between south-east Asia and

Australia, it is likely the result of male gene flow (Phillips et al. 2011; Faria et al. 2013; DOE 2015b).

Within northern Australia, analyses of a portion of the mitochondrial control region across 149 individuals indicated the existence of several barriers to gene flow at a broad scale (Phillips et al. 2011). For example, the assemblages on the west coast of Australia and the Gulf of Carpentaria (GOC) appeared to represent distinct maternal subpopulations, which likely reflects philopatric behaviour of the females (i.e., returning to sites previously used for reproduction). More recently, analyses of whole mitochondrial sequences of 92 largetooth sawfish from 7 river drainages across northern Australia revealed barriers to gene flow at a scale as fine as between adjacent river drainages (Feutry et al. 2015). Except for those flowing into the GOC, all river drainages appeared to host a genetically distinct subpopulation. The apparent genetic homogeneity in the GOC may be due to freshwater connectivity between river drainages, either during the last glaciation event when the GOC was a freshwater lake or through contemporary wet season flooding (Feutry et al. 2015).

Genetic evidence suggests that female largetooth sawfish have strong reproductive philopatry, although it remains unknown whether they move large distances from their natal region outside of breeding or pupping times (Phillips et al. 2011). Regardless, reproductive philopatry may reduce the species' adaptability to anthropogenic impacts or environmental change. For example, individual females may return to the same place to reproduce even if conditions there become unfavourable, which may compromise offspring survival or fitness (Yates et al. 2012). Furthermore, recovery after localised depletion will be slow compared to less philopatric species because there may be relatively less replenishment from production in other areas (Hueter et al. 2004; Phillips et al. 2011; Yates et al. 2012).

In contrast to females, male largetooth sawfish disperse between at least WA, the Northern Territory (NT) and the GOC (Phillips 2011). The presence of male gene flow between assemblages in Australian waters suggests that removal of males in one location could affect the abundance or genetic assemblages in other locations (Phillips 2011).

Habitat critical to the survival

A description of 'Habitat critical to survival' for a species is outlined in the Significant Impact Guidelines 1.1. Habitat critical to the survival of the species should not be destroyed or modified. Actions that have indirect impacts on habitat critical to survival should be avoided, as should any actions that compromise the species' survival across all life stages.

No Critical Habitat as defined under section 207A of the EPBC Act has been included in the Register of Critical Habitat. Given the strong anecdotal evidence of population declines and the lack of detailed information on the species' distribution, the Threatened Species Scientific Committee considers habitat where the largetooth sawfish has been verified displaying biologically important behaviour such as breeding, pupping, migrating or nursery sites are considered crucial for the ongoing survival and recovery of the species in Australian waters, unless population survey data suggests otherwise (DOE 2015a). Surveys in some remote areas are lacking, and all river systems in Australia within the species' range should be considered as important to the species' survival unless population survey data suggests otherwise.

Based on an analysis of collated fisheries-independent catch data spanning years 2000–2021 (see Patterson et al. 2021), some rivers had relatively high catch-per-unit-effort, indicating that they likely support a significant proportion of the species' Australian population. These are the Fitzroy (WA), Archer, Victoria, Daly and Adelaide Rivers. These rivers, and potentially others, are likely necessary for the persistence of the species, such that adversely impacting habitat in those areas would reduce the viability of the species or otherwise jeopardise the persistence of the species. As discussed in the previous section, strong reproductive philopatry likely means that recovery after localised depletion will be slow or may not occur. Hence the Fitzroy (WA), Archer, Victoria, Daly and Adelaide Rivers are also considered irreplaceable.

Reproductive philopatry by female largetooth sawfish also amplifies the importance of rivers that contain individuals with unique haplotypes. Some of these include King Sound; the Fitzroy, Durack, Robinson and Ord Rivers in WA; the Van Diemen Gulf drainages and the Daly and Victoria Rivers in the NT; the GOC and the rivers of western Cape York in Qld; and Princess Charlotte Bay drainages in Qld (reviewed in DOE 2015a, b).

The Committee recommends that largetooth sawfish habitat within the aforementioned rivers be described and spatially defined, and that these defined habitats then be listed as Critical Habitat on the EPBC Act Register of Critical Habitat. The habitat for this species spans WA, NT and Qld state waters and therefore consultation must be undertaken on this matter with those governments.

In addition to areas of currently known importance, the maintenance of contributions from a diverse range of river systems may reduce variability in the overall production of adults and maintain population resilience (Yates et al. 2012). Linking early life stage conservation with protection of older individuals in marine environments will also be critical to halt population decline and promote recovery (discussed for elasmobranchs in Kinney et al. 2009).

Important populations

An 'important population' is a population that is necessary for a species' long-term survival and recovery. All populations of largetooth sawfish in Australian waters are of extremely high conservation value for the species' long-term survival and recovery in Australia and elsewhere (eds Harrison and Dulvy 2014; Simpfendorfer et al. 2019) and are therefore considered as important populations. In particular, the previous section identifies rivers (and hence largetooth sawfish populations, given strong reproductive philopatry in this species) that are likely of high conservation significance.

In this section, the word 'population' is used to refer to a subpopulation, in keeping with the terminology used in the EPBC Act and state/territory environmental legislation.

Threats

The largetooth sawfish has undergone significant, albeit largely unquantified declines in Australian waters and there is no evidence of population recovery (Kyne et al. 2021b). Reliance on a variety of habitats makes the species susceptible to a variety of historical and ongoing threats.

The potential for cumulative impacts from multiple threats is of high concern. The text that follows Table 1 lists additional threats that are poorly understood or of minor consequence to the species and as such they have not been included in Table 1.

The primary threats in Australia are: (1) capture as bycatch in commercial fisheries managed by Qld, NT and the Commonwealth and (2) habitat loss and degradation caused by climate change and water resource development (Table 1). This conclusion is in accordance with a recent global meta-analysis that identified interactions with fisheries and anthropogenic habitat modifications as the main causes of local extirpations of sawfishes (Yan et al. 2021). As described in Table 1, WA fisheries pose less of a threat presently due to lower current fishing pressure when compared to other jurisdictions and partial protection provided by marine parks.

Table 1: Threats

Threats in Table 1 are noted in approximate order of highest to lowest impact, based on available evidence.

Threat	Status [a]	Evidence
Climate change		
Change to air and sea temperatures, rainfall and ocean chemistry	• Timing: current and future • Confidence: observed and projected • Likelihood: almost certain • Consequence: major • Trend: increasing • Extent: across the entire range	**Timing**: Northern Australia is already experiencing the impacts of climate change (e.g., reviewed in NESP ESCC Hub 2020). Factors that are changing include temperature, rainfall, extreme events such as cyclones, sea surface temperature, sea level, marine heatwaves, and ocean chemistry (reviewed in NESP ESCC Hub 2020). **Confidence and likelihood**: Largetooth sawfish have been assessed as having moderate overall vulnerability to climate change, based on calculations of exposure, sensitivity and adaptive capacity (Chin et al. 2010, note species identified as *P. microdon*, freshwater sawfish in this paper). In WA, increased drought frequency was the largest driver of modelled declines using PVA (Grant 2022). **Consequence**: Bioenergetic modelling indicates that even small increases in temperature due to climate change may compromise the ability of juvenile largetooth sawfish to grow and survive in elevated temperatures and energy-limiting circumstances during the dry the season (e.g., low quality or quantity of prey, coupled with intrinsic physiological limitations related to high water temperature) (Lear et al. 2020). Furthermore, ongoing changes in the character of precipitation are predicted, e.g., more intense heavy rains may be accompanied by longer dry spells (Trenberth et al. 2013). Whitty et al. (2009) attributed a decline in juvenile abundance to low recruitment driven by low rainfall. More research is needed to determine the implications of climate change for the ability of largetooth sawfish to recruit into their nursery and survive successive dry seasons (Lear et al. 2019, 2021). **Trend and extent**: The climate of northern Australia, encompassing the entire Australian distribution of largetooth sawfish, is projected to continue to change into the future (e.g., NESP ESCC Hub 2020).
Mortality in Australian commercial fisheries		

Threat	Status [a]	Evidence
Mortality in Queensland-managed fisheries	• Timing: current and future • Confidence: observed • Likelihood: likely • Consequence: major • Trend: decreasing (east coast) and static (Qld GOC) but predicted to decrease • Extent: across part of its range	**Timing**: The Qld Fish Board began recording commercial landings of 'sharks' (unspecified) in Qld-managed fisheries in the 1974–75 fishing season (Leigh 2015). Gillnet fishing did occur in Qld waters prior to 1974 and is presumed to have caught largetooth sawfish, however data on its temporal or spatial extent are not available. Interactions with sawfishes continue to occur in the East Coast Inshore Finfish Fishery (ECIFF), Gulf of Carpentaria Inshore Finfish Fishery (GOCIFF) and East Coast Otter Trawl Fishery (ECOTF) (Pillans et al. 2022). The Qld River and Inshore Beam Trawl Fishery and the Qld Commercial Trawl (Fin Fish) Fishery also have the potential to impact sawfishes. Gillnet reforms are underway in Qld. The following management changes in Qld are predicted to change the status of commercial fishing threat, as of 1 January 2024: • Commercial gillnets and small bait mesh nets were banned from the northern third of the Great Barrier Reef World Heritage Area (from Cape Bedford to the tip of Cape York, i.e. east coast management region 1). • large mesh gillnet licences (N1, N2 and N4) are legally revoked from the Great Barrier Reef World Heritage Area. A transition period has been implemented, allowing up to 40 NX licences to operate in east coast inshore management regions 2, 3 and 4. The new NX licence is a limited-entry and limited-term licence that will not be able to be operated beyond 2027. • Independent Onboard Monitoring is a condition of the NX gillnet licences in the GBRWHA, including species specific reporting of discarded species. Additionally, new gillnet free fishing zones commenced in May 2024 within the GOC. Legislation to mandate Independent Data Validation for fisheries reporting has been introduced to Qld parliament. **Confidence**: Observer coverage in state and territory gillnet fisheries, including Qld, has been very low since mid-2005 (Salini et al. 2007). As a result, there are no reliable estimates of catch rates. Sawfish interactions are reported by fishers in Species of Conservation Interest (SOCI) logbooks, however under- or nil-reporting is known to occur in Qld-managed fisheries (Pillans et al. 2022, b; Wueringer et al. 2023). Total reported sawfish interactions in each of the ECIFFF and GOCIFF range from < 10 to > 250 individuals per year, ~10% of which are reported to be largetooth sawfish and ~9% are not reported to species level (Pillans et al. 2022). Independent monitoring and data validation is a condition on the transitional NX gillnet licences and therefore confidence in data and interactions should improve. An independent monitoring and data validation program is also being explored on the ECOTF with a head of power being progressed through parliament to make it mandatory – however timelines on this are unclear. The majority (92%) of sawfish were reported from net fishing (gillnet, haul net and tunnel net) with all other records from otter trawl fishing (Pillans et al. 2022). No data are yet available to inform to what extent the threat of commercial fishing in Qld is reduced by the 2023-24 fisheries reforms, including the phase-out of gillnet licenses in the ECIFFF. **Likelihood**: The toothed rostra of sawfishes make them highly susceptible to entanglement in various fishing gears. The susceptibility of sawfish to capture in various fishing gears (especially nets) and their high intrinsic vulnerability to mortality in fisheries are widely documented (e.g., reviewed in Dulvy et al. 2014; Simpfendorfer et al. 2019; Kyne et al. 2021b; Espinoza et al. 2022). Level 1 & 2 Ecological Risk Assessments completed for the ECIFF and GOCIFF categorised largetooth sawfish at high risk (Jacobsen et al. 2019; 2021).

Threat	Status [a]	Evidence
		Consequence: There is strong anecdotal evidence of population size reduction and range contraction of largetooth sawfish in Qld waters (Attachment A; Appendix 1). The species is now rare on the Qld east coast, including in places where it was once described as 'very common' (Stevens et al. 2005). Largetooth sawfish can survive capture in nets if they are handled carefully (Whitty et al. 2009). In Australian waters, fishers are permitted to kill sawfish if disentanglement is considered dangerous (DOE 2015b) and for this reason live release has been rarely practised in the past (Stevens et al. 2008). **Trend**: Efforts in both the GOCIFF and ECIFF fisheries have undergone declines whereas effort in the east coast otter trawl fishery has been relatively stable since 2010 (Pillans et al. 2022). Into the future the threat from fishing in Qld is predicted to decrease, with the Great Barrier Reef World Heritage Area to be gillnet free by the middle of 2027 and new gillnet-free fishing zones proposed to commence in May 2024 within the GOC. This will be dependent on whether reduction in gillnet effort leads to increases in alternative methods and their relative risk profile in relation to interactions with largetooth sawfish. **Extent**: Qld waters represent part of the species' distribution within the Australian EEZ. Interactions occur in estuaries and coastal environments (Peverell 2005). Closed areas within the Great Barrier Reef Marine Park and the closure of rivers in Princess Charlotte Bay to gillnetting and future removal of gillnets in the Great Barrier Reef Marine Park and GOC may also provide refuge from fishing pressure. Spawning closures designed for *Lates calcarifer* (Barramundi), mostly during the summer wet season, may also benefit largetooth sawfish (Kyne et al. 2013).
Mortality in Northern Territory-managed fisheries	• Timing: current and future • Confidence: observed • Likelihood: likely • Consequence: major • Trend: static • Extent: across part of its range	**Timing**: Fishing mortality of largetooth sawfish is ongoing in inshore gillnet fisheries around northern Australia, including in the NT (Kyne et al. 2013; Pillans et al. 2018; Simpfendorfer et al. 2019; Udyawer et al. 2024). The NT Barramundi Fishery (gillnet) has the most interactions with sawfish (Pillans et al. 2022). The NT Offshore Net and Line Fishery (ONLF) operates in offshore regions in the NT, particularly around the GOC, and is not thought to pose a significant threat to sawfish although they have been recorded as bycatch (DOE 2015b). **Confidence**: Between 1983 and 2005, all sawfish caught in the NT ONLF were recorded collectively as 'sawfishes' (Field et al. 2013). In the NT Barramundi Fishery during 1983–2005, all sawfish were recorded collectively within a 'sharks' category (Field et al. 2013). As described in the Qld fisheries section, observer coverage in state and territory gillnet fisheries has been very low since mid-2005 (Salini et al. 2007). As a result, there are no reliable historical estimates of catch rates of sawfish in NT-managed fisheries. Over the 5 years to 2023/24, 3 interactions with largetooth sawfish (all released alive) have been reported in logbooks in the ONLF. Annual reported interactions from logbooks range between 0 – 2 individuals. On-board observer programs reported one interaction with the species over the last 20 years. Underreporting of sawfish interactions is an acknowledged issue, and therefore reported levels of interactions with largetooth sawfish are not reliable (Pillans et al. 2022b). **Likelihood**: The susceptibility of sawfish to capture in various fishing gears (especially nets) and their high intrinsic vulnerability to mortality in fisheries are widely documented (e.g., reviewed in Dulvy et al. 2014; Simpfendorfer et al. 2019; Kyne et al. 2021b; Espinoza et al. 2022). The largest drivers of declines based on population viability analyses (PVA) were commercial fishing in the NT and the Qld GOC (Grant 2022). A 2024 Ecological Risk Assessment categorised the NT ONLF to be of 'low' risk to largetooth sawfish (Northern Territory Government 2024), and that it is 'possible' that some level of interactions would occur but few

Threat	Status [a]	Evidence
		mortalities would occur each year. The previous risk rating in 2020 was 'moderate'. **Consequence:** There is strong anecdotal evidence of population size reduction of largetooth sawfish in NT waters (Attachment A; Appendix 1). **Trend**: There is no evidence to suggest that the level of threat for largetooth sawfish is increasing or decreasing in the NT. However, a 2024 announcement by the NT Government to phase out commercial gillnets over four years will likely assist in the recovery of the species. **Extent**: The NT ONLF extends across the NT coastline, from the low-water mark to the boundary of the Australian Fishing Zone (Northern Territory Government 2020). The NT Barramundi Fishery operates in tidal mud flats and inside some rivers. Spatial closures in riverine, estuarine and coastal waters in the NT Barramundi Fishery offer largetooth sawfish some refuge from commercial gillnet fishing activities (Kyne et al. 2013). NB: Categorisations in 'status' column are based mainly on the NT Barramundi Fishery which has the most interactions with sawfish (Pillans et al. 2022).
Mortality in Commonwealth managed fisheries	• Timing: current and future • Confidence: observed • Likelihood: likely • Consequence: moderate • Trend: static • Extent: across part of its range	**Timing**: The Northern Prawn Fishery (NPF) is primarily an otter trawl fishery targeting several prawn species across northern Australia. Interactions with largetooth sawfish have been recorded in the NPF (Pillans et al. 2022, b). **Confidence and likelihood**: There were significant improvements in the reliability of sawfish reporting during years 2020–2021. This included finer resolution of species identification, with 86% of sawfishes reported to species level (Pillans et al. 2022). **Consequence**: Observer data from the NPF has indicated that mortality of sawfishes brought on deck is approximately 90% (Salini et al. 2007). More recently, 433 sawfish (species pooled) interactions in 2019 were reported by AFMA, of which 349 (81%) were released alive, 79 (18%) were dead, 4 were injured and 1 was released in unknown condition (Patterson et al. 2020). Variability in data on capture and post-release mortality between studies means that total mortality is poorly understood. **Trend**: Given the scarcity of data on species-specific post-release survival, it remains unknown whether releasing animals is an effective management strategy to reduce fishing mortality (Salini et al. 2007). **Extent**: The NPF is located off Australia's northern coast from Cape York in Qld to Cape Londonderry in WA. Heupel et al. (2018) calculated the spatial overlap between the distribution of largetooth sawfish and Australian Marine Parks (AMP). Twenty-nine percent of the species' range occurs in AMP and 4% occurs within areas of AMPs that are closed to all forms of fishing. This suggests that this species is gaining limited protection from fishing based on protections within AMPs. This analysis did not include protected areas managed by state and territory governments, and therefore it provides a conservative estimate of the degree of overlap with protected areas (Heupel et al. 2018). The degree of overlap between fisheries and the distribution of largetooth sawfish is not necessarily indicative of level of risk because the amount of fishing effort varies by time and location. To assess the benefits of closed areas and seasons that are not specifically designed for sawfish, information on largetooth sawfish long-term movement patterns and habitat use are required (Kyne et al. 2013).
Mortality in Western Australia-managed fisheries	• Timing: primarily past • Confidence: inferred • Likelihood: likely	**Timing:** Although mortalities continue to occur in WA-managed fisheries, largetooth sawfish populations in WA are currently subject to lower fishing pressure compared to other parts of the species' Australian distribution. This threat is considered predominantly as 'past' given that the species is not inferred to have recently declined in WA waters (Espinoza et al. 2022). The WA-managed fisheries that are most likely to interact with largetooth sawfish are the Kimberley Gillnet and Barramundi Managed Fishery (KGBMF) and the Kimberley Prawn Managed Fishery (KPMF).

Threat	Status [a]	Evidence
	• Consequence: moderate • Trend: static • Extent: across part of its range	**Confidence and Likelihood:** The KGBMF is operated in mangrove creek habitats and not freshwater parts of rivers. Recent observer data from this fishery indicates largetooth sawfish are not regularly caught (A Harry 2023. unpublished data 22 March 2023), which is consistent with historic observer data (e.g., McAuley et al. 2005). Observer data are scarce for the KPMF, although it is presumed to pose a low level of risk to largetooth sawfish due to the small size of the fishery. **Consequence and trend:** WA-managed fisheries are considered to be of lower current risk for largetooth sawfish, compared to Qld and NT, because historical and current fishing pressure has been lower and WA-managed marine parks provide partial protection, although there is no formal assessment as such (A Harry 2023. pers comm 22 March 2023). Over the last 2 decades, there has also been a reduction in the intensity of inshore fisheries of northern WA, including the closure of nearshore gillnet fisheries (reviewed in Harry et al. 2024), which likely captured large amounts of sawfish. The WA North Coast Shark Fishery also captured sawfish but was closed in 2005 (reviewed in Harry et al. 2024). Based on observer data and expert opinion, < 33% of largetooth sawfish are estimated to survive capture and release in the KGBMF and the (now closed) Eighty Mile Beach Gillnet Fishery, WA (Salini et al. 2007). **Extent:** Much of the Kimberley coastline is covered by state and commonwealth marine parks, including some sanctuary zones that may provide protection for largetooth sawfish.
Habitat loss and degradation		
Water resource development (WRD) and alterations to river courses	• Status: current and future • Confidence: known • Likelihood: likely • Consequence: major • Trend: increasing • Extent: across part of its range	**Status**: The main contributor to the modification of sawfish habitats in Australia is water resource development (WRD). This includes damming of rivers, water abstraction and other alterations to riverine habitats or flow regimes (eds Harrison and Dulvy 2014; Lear et al. 2020; Lear et al. 2021). Of particular concern are the potential cumulative effects of uncoordinated adjacent developments, which may be constructed without consideration of the movement patterns of coastal species such as largetooth sawfish (Lear et al. 2024). **Confidence**: Habitat loss and modification have been major drivers of population declines across much of the species' former range throughout the Indo-West Pacific (eds Harrison & Dulvy 2014). Impacts have already been observed in Australia (e.g., see DSEWPaC 2011; Kyne et al. 2013; Simpfendorfer et al. 2019; Lear et al. 2019, 2021). Lear et al. (2019) used standardised catch data spanning 17 years to investigate the relationship between wet season volume and the abundance of largetooth sawfish within the Fitzroy River, WA, nursery. The results indicate that largetooth sawfish rely almost entirely on years with large wet season floods, and the brief periods of highest water levels within these years, to replenish juvenile populations in the Fitzroy River nursery. These crucial patterns of flooding can be altered by water extraction and if dams or other large obstructions are introduced to river systems (Doupé et al. 2005; Gill et al. 2006). Similarly, Whitty et al. (2009) report a decline in the relative abundance of largetooth sawfish in the Fitzroy River during 2002–2008. This decline is attributed to low recruitment in the preceding years, which is in turn attributed to low rainfall in those years. Largetooth sawfish show high sensitivity and population impacts in almost all WRD scenarios tested in empirical models by Plagányi et al. (2022). All scenarios other than those with very low water extraction volumes were predicted to result in severe local declines. Results suggested greater sensitivity to WRD scenarios involving water extraction compared with water impoundment by dams (assuming free movement of the animals past the dams).

Threat	Status [a]	Evidence
		In coastal waters, acoustic tracking and catch data on green sawfish (*Pristis zijsron*) indicate that large coastal developments constrained the movements of juveniles moving throughout the nursery (Lear et al. 2024). It is possible that largetooth sawfish inhabiting shoreline environments may be reluctant to travel around large or unfamiliar coastal structures. **Consequence**: Examples of the consequences of WRD can be seen in the Ord River, WA. This river contains multiple large dams that have significantly disrupted river flow dynamics (Gill et al. 2006). Fish assemblages in the Lake Kununurra section of the river changed post damming, with largetooth sawfish absent in the lake despite being present below the dam (Thorburn et al. 2003). The low relative abundance of largetooth sawfish in the Ord River has been attributed to insurmountable barriers to movement (Gill et al. 2006) and flow-regime disruptions (Lear et al. 2019). Water abstraction can also decrease the depth of pools, thereby eliminating cooler-water refuges and compromise the ability of largetooth sawfish to mitigate rising temperatures through behavioural thermoregulation (Lear et al. 2020). Dams, barrages and road crossings can impede movements by largetooth sawfish and cause localised aggregations of individuals. This can lead to increased rates of predation and incidental capture by fishers (Thorburn et al. 2003, 2004; Morgan et al. 2005; Stevens et al. 2005; DOE 2015b). For example, Morgan et al. (2005) reported that almost all sawfish captured during research surveys at Camballin Barrage, WA, had fishing line either wrapped around their rostrum or coming out of their gill openings. Additionally, light and noise pollution from river and coastal developments may impact the behaviour and spatial ecology of sawfish (Lear et al. 2024). **Trend**: Northern Australia is the current focus of substantial economic development (Udyawa et al. 2021). There is the potential for increased freshwater extraction from tropical rivers across northern Australia as agriculture and the mining industry continue to expand (Petheram et al. 2018, CSIRO 2018; Lear et al. 2019; Government of WA 2020). Throughout the species' range, the development of tidal power-generating facilities in coastal areas may also increase threats by restricting access to important habitats or by physically harming sawfish (eds Harrison and Dulvy et al. 2014). **Extent**: Large dams currently exist in several rivers throughout the species' Australian range, including the Ord River, WA, the Darwin River, NT, and Leichhardt River, QLD. There is also the potential for cumulative impacts with other types of barriers, such as vehicle crossings. WA is the only region where largetooth sawfish is not inferred to have recently declined (Espinoza et al. 2022). Monitoring of the Fitzroy River, WA, since 2002 indicated stable and fluctuating recruitment linked with environmental conditions (Lear et al. 2019, Lear et al. 2020, Lear et al. 2021), indicating that the productivity of the subpopulation likely remains high (Espinoza et al. 2022). However, WRD poses major and ongoing threats to the important refuge population of largetooth sawfish in WA (Espinoza et al. 2022).

[a]Timing—identifies the temporal nature of the threat
Confidence—identifies the nature of the evidence about the impact of the threat on the species
Likelihood—identifies the likelihood of the threat impacting on the whole population or extent of the species
Consequence—identifies the severity of the threat
Trend—identifies the extent to which it will continue to operate on the species
Extent—identifies its spatial context in terms of the range of the species

Categories for likelihood are defined as follows:
Almost certain – >90% chance that threat will have an impact on the species within the next 3 generations or 10 years, whichever is longer
Likely – 66-90% chance that threat will have an impact on the species within the next 3 generations or 10 years, whichever is longer

Possible – 33-66% chance that threat will have an impact on the species within the next 3 generations or 10 years, whichever is longer
Unlikely – <33% chance that threat will have an impact on the species within the next 3 generations or 10 years, whichever is longer
Unknown – probability that threat will have an impact on the species within the next 3 generations or 10 years, whichever is longer, could be 0-100%
Categories for consequences are defined as follows:
Catastrophic – affecting survival, reproduction or essential movement of individuals in >80% of the population or across >80% of the distribution within the next 3 generations or 10 years, whichever is longer
Major – affecting survival, reproduction or essential movement of individuals in 50-80 % of the population or across 50-80% of the distribution within the next 3 generations or 10 years, whichever is longer
Moderate – affecting survival, reproduction or essential movement of individuals in 20-50% of the population or across 20-50% of the distribution within the next 3 generations or 10 years, whichever is longer
Minor – affecting survival, reproduction or essential movement of individuals in 5-30% of the population or across 5-30% of the distribution within the next 3 generations or 10 years, whichever is longer
Not significant – affecting survival, reproduction or essential movement of individuals in <5% of the population or across <5% of the distribution within the next 3 generations or 10 years, whichever is longer

The following threats are poorly understood or of minor consequence to the species and as such they have not been included in Table 1:

Recreational line fishing: A small amount of the estimated overall bycatch of sawfishes in Australia is attributed to recreational fishing (0.3%, Stevens et al. 2005). Recreationally caught largetooth sawfish have been killed for the 'trophy' rostrum and to retrieve fishing gear (Thorburn et al. 2003). The species is also susceptible to entanglement in discarded or lost recreational fishing gear (Thorburn et al. 2004a, b).

Queensland Shark Control Program: Records of sawfish catches in Australia begin with the start of the Qld Shark Control Program (QSCP) in 1963. Mortality in the QSCP has been categorised as a minor source of mortality for largetooth sawfish (Kyne et al. 2021a). A total of 1450 captures of sawfishes (all species pooled) was reported from 1963 to August 2016, > 99 % of which were in the northern-most areas (Cairns, Townsville, Mackay, and Rockhampton), and 95.4 % were alive when the gear was checked. Between 1996 (when data became more detailed) and 2016, 94.3 % of sawfish captures occurred in gillnets, none occurred on drum lines, and only 5.7% were recorded as 'Other' (presumably a mix of gillnet and drumline catches) (Wueringer 2017). There is evidence of large declines in the catch rates of sawfishes in QSCP nets (see Attachment A). No sawfish captures in QSCP gear have been recorded in Cairns, Townsville or Rockhampton since QSCP nets were removed from those locations. Four sawfish were recorded during 2000–2016 in Mackay, where QSCP nets are still in operation (Wueringer 2017).

Illegal, unreported and unregulated (IUU) fishing: The primary historic IUU threat has been from vessels involved in the shark fin trade fishing illegally within Australian waters (Stevens et al. 2005; Lack & Sant 2008; Field et al. 2009; Marshall 2011). In 2005, illegal foreign catches of 'shark' in the GOC were believed to be at least equivalent to those caught legally by domestic vessels (Pascoe et al., 2008). These levels are thought to have since decreased (Lack & Sant, 2008) to the point where IUU fishing is not listed as a threat for largetooth sawfish in Kyne et al. (2021b). However, global social and economic shifts (e.g., epidemics and natural disasters) can result in increased illegal foreign fishing in Australia. Post 2021, the declining economic opportunities in Indonesia and reduced compliance in Australia due to COVID-19 restrictions have contributed to illegal fishing levels higher than any seen in the previous 15 years (AFMA

2023). The ongoing unreported component of largetooth sawfish interactions in Australian commercial fisheries is discussed in Table 1.

First Nations fishing: The magnitude and spatial distribution of harvest of largetooth sawfish by First Nations Peoples is unknown (DOE 2015b). Given the low level of connectivity between rivers across northern Australia, this harvest has the potential to contribute to localised depletions, although this has not been demonstrated.

Collection for display in public aquaria: Sawfishes have been displayed in public aquaria for > 70 years (Buckley et al. 2020). The captive Australian population of largetooth sawfish is not self-maintaining (Buckley et al. 2018) and collection is ongoing in NT and Qld for use in domestic aquaria only (DOE 2015b). Largetooth sawfish have also been harvested in Australian waters for the purpose of export for display in overseas public aquaria, however this has not occurred since the uplisting of the species from Appendix II to Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2013. CITES Appendix I prohibits any international trade for commercial purposes.

Pollution: Chemical pollution or contamination from agricultural activities, development, and onshore and offshore mining operations is of potential concern for sawfishes (eds Harrison and Dulvy 2014). For example, pesticide contamination has been suggested to alter endocrine and immune function in elasmobranchs occurring in freshwater habitats (Gelsleichter et al. 2006). Mining activities are also a potential risk through freshwater habitat alteration or pollution events (Kyne et al. 2013; Simpfendorfer et al. 2019).

Crocodile predation: The Australian population of salt-water crocodile (*Crocodylus porosus*), a natural predator of largetooth sawfish, is considered to have recovered to carrying capacity (Morgan et al. 2005; Fukuda et al. 2011). It is plausible that the higher density of salt-water crocodiles relative to largetooth sawfish may inhibit population recovery and contribute to further population decline. An experimental application of high crocodile predation in PVA produced heavy declines in all jurisdictions (at least -55%, Grant 2022). However, these dynamics have not been demonstrated with observed data. Predation of young-of-the-year largetooth sawfish may be exacerbated by animals congregating in estuarine pools during the dry season, particularly in years with low riverine flow (Morgan et al. 2017; Buckley et al. 2020; Lear 2019; Grant 2022). Hence predation pressure may interact with the effect of low wet season rainfall, resulting in reduced annual recruitment of largetooth sawfish (Lear et al. 2019).

Foreign fleets in Australian waters (historic threat): Soviet and Taiwanese trawl and gillnet fisheries operated off the Qld GOC, NT and northern WA from 1966 until the early 1990s (all fisheries pooled) (reviewed in Stevens et al. 2005 & Leigh 2015). Data on sawfish catches, including largetooth sawfish are scarce and indicate that reporting practices were not consistent (Stevens et al. 2005).

The risk matrix (Table 1) provides a visual depiction of the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In preparing a risk matrix, several factors have been taken into consideration: the life stage they affect; the duration of the impact; the spatial extent, and the efficacy of current management regimes, assuming that management will continue to be applied appropriately. The risk matrix and ranking of threats has been developed in consultation with experts and using available literature.

Table 1: Risk Matrix

Likelihood	Consequences					
	Not significant	Minor	Moderate	Major	Catastrophic	Unknown
Almost certain				Change to air and sea temperatures, rainfall and ocean chemistry (climate change)		
Likely			Commonwealth fisheries WA-managed fisheries	Qld-managed fisheries NT-managed fisheries Water resource development		
Possible						
Unlikely						
Unknown		Recreational line fishing Qld Shark Control Program Collection for public aquaria				Crocodile predation IUU fishing Pollution Foreign fleets in Australian waters First Nations fishing

Risk Matrix legend/Risk rating:

Low Risk	Moderate Risk	High Risk	Very High Risk

Priority actions have then been developed to manage the threats, particularly where the risk was deemed to be 'very high' (red shading) or 'high' (orange shading). For those threats with an unknown/low or moderate risk (green, blue or white shading respectively) research and monitoring actions have been developed to understand and evaluate the impact of the threats, where appropriate.

Conservation and recovery actions

The 2015 Sawfish and River Sharks Multispecies Recovery Plan (DOE 2015a) constitutes the Australian national recovery plan for largetooth sawfish. The Recovery Plan outlines the conservation requirements for the species across its range, identifies the actions to be taken to ensure its long-term viability in nature and the parties that will undertake those actions. This conservation advice aligns with and builds on the 2015 Recovery Plan and provides a more contemporary assessment of threats to the species and critical conservation actions required to ensure its recovery.

Primary conservation objectives

The primary objectives are to (1) prevent further decline of any largetooth sawfish subpopulations (e.g., population units that are isolated from others via reproductive philopatry) and (2) ensure the recovery of the largetooth sawfish across its Australian range.

Conservation and management priorities

Priority actions are categorised as either urgent (18 months) or medium-term (4 years). These categorisations account for likely timeframes for completion. For example, work to determine whether the largetooth sawfish is subject to ongoing decline is considered a high priority albeit unlikely to be completed within 18 months.

Commercial fisheries

Urgent actions

1) Introduction of bycatch mitigation strategies, designed specifically for largetooth sawfish, focussed on (1) significantly reducing the number of interactions within fisheries and (2) increasing post-release survival. Key components may include:
    a) Reduced soak times or requirements for fishers to be in attendance of nets.
    b) Gear restrictions and modifications aimed at preventing entanglement (including net tightness and bycatch reduction devices).
    c) Spatiotemporal closures specifically designed to avoid interactions with largetooth sawfish during high-risk periods (especially of known nursery areas, aggregation sites, and important habitat for the species such as rivers with relatively high abundance).
2) All relevant jurisdictions to implement a robust fisheries monitoring program, including independent validation, which provides accurate reporting of interactions with largetooth sawfish. Sampling designs should have sufficient statistical power to calculate total mortality and recovery within each fishery with high confidence. Key components of a program should include:
    a) Fisheries-independent on-board observers and/or electronic monitoring.
    b) Validation of data, i.e., comparison of independent monitoring data with fisher logbook data. There is an expectation that misreporting or under-reporting does not occur, and any discrepancies are minimal and can be explained.
    c) Accurate species-level reporting for all interactions with sawfish.
    d) Collection of biological data from all caught sawfish including morphometrics, weight (where possible), sex, fate and release condition. Tissue collection from all caught

sawfish for contribution to the national Close Kin Mark Recapture (CKMR) estimates of population abundance and trend (action 24).

3) Education and training programs to increase awareness and competency within the fishing industry around safe handling practices to improve survival of released sawfish and increase accuracy in species identification and species-specific reporting.

Medium-term actions

4) Enhanced/validated fisheries-independent data on total mortality (action 2) and new information about the population (action 24) should support setting interaction limits on fisheries that interact with largetooth sawfish. Limits may be applied to biologically appropriate spatial units to enable recovery of the species and subpopulations.

    a) Where there is uncertainty in establishing the impact of fishing mortality on the population/subpopulation, a precautionary limit should be set through consultation with species experts and stakeholders and, where relevant, evaluated through assessments under the EPBC Act (e.g., s208A, Part 13A).

5) The efficacy of the suite of measures in place in fisheries (such as adjustments to fishing effort, limits on interactions applied to spatial units, and bycatch mitigation/reduction measures) for reducing total mortality should be reviewed periodically to ensure their adequacy to enable recovery of the species (including subpopulations). The review should account for cumulative sources of mortality across fisheries and jurisdictions.

6) Undertake cumulative Ecological Risk Assessments (ERAs) for the largetooth sawfish, to understand cumulative impacts of fishing mortality across multiple sectors/fisheries (e.g., Zhou et al. 2019).

7) Investigate complementary management measures in areas used by largetooth sawfish at different life stages, (for instance mouths of rivers and in estuaries for pupping, upriver for the first 4–5 years, then the marine environment as adults), to ensure that inadequate management in one environment does not undermine management efforts in others.

8) Any new fishing operation (including gear-type change), or expansion of existing operations be assessed appropriately for the impact on sawfish and based on appropriate data. If information on species presence in an area is not attainable, then a time/interaction-limited trial to examine whether the expansion will impact largetooth sawfish might be designed. This should include safeguards to ensure the trial itself does not pose a risk to the species and catch validation to ensure that interactions are reported accurately.

9) Implementation of mechanisms to ensure compliance with prohibitions on targeting, landing and on-selling largetooth sawfish. These may include a combination of independent onboard monitoring, vessel monitoring systems, monitoring of landing sites, auditing stockpiles of shark product, analysis of fisheries product exports, and monitoring of the sale of products.

Water resource development and alteration

Urgent actions

10) Ensure that proposed developments will not have a significant impact upon largetooth sawfish habitats, including recruitment or migration ability. Consider cumulative impacts of all current and proposed developments across the species' range. This may include limiting

water abstraction where it is likely to adversely impact the species, especially during years with below-average rainfall/river-flow volume.

Medium-term actions

11) Determine the effect of existing river and estuarine barriers to the movements of largetooth sawfish. Undertake an audit of existing barries and, where possible, remove or modify barriers for the purpose of improving connectivity of largetooth sawfish habitat or alleviating threats to the species.

Climate change and severe weather impacts

Medium-term actions

12) Foster resilience to climate change by protecting important habitats for all largetooth sawfish life stages and restoring habitats that may buffer against climate change impacts.

Stakeholder engagement/community engagement

Urgent actions

13) Develop and implement an engagement plan to inform stakeholders and partners across all sectors (commercial, recreational, First Nations, and domestic aquarium trade) about the EPBC Act listing status of the largetooth sawfish and its practical implications. It is important to note that under the Native Title Act 1993, listing of the largetooth sawfish under the EPBC Act does not change the rights of Native Title holders to fish the species for personal, domestic and non-commercial communal needs.

14) Ensure Traditional Owners/Custodians are fully consulted about, and provided the opportunity to participate in, the management of largetooth sawfish occurring within their traditional waters.

15) In collaboration with commercial and recreational fishers, implement a program to ensure fisher knowledge informs the implementation of EPBC Act requirements. This could include methods and drivers to enable avoidance and mitigation of interactions, and best practice handling and release techniques for incidental interactions with largetooth sawfish.

Medium-term actions

16) In collaboration with First Nations communities, develop and implement a program to integrate Traditional Ecological Knowledge and non-Indigenous scientific knowledge to facilitate two-way learning and improve conservation outcomes for the largetooth sawfish. For example, this integration could enhance long-term baselines for population assessments, understanding of the species' ecology, and any customary management systems in place. Such knowledge may be held by First Nations Peoples who are the custodians of this knowledge and have the rights to decide how it is shared and used. Such a program could involve Indigenous Ranger programs, and the Indigenous Protected Area and Traditional Use of Marine Resource Agreement (TUMRA) groups.

Survey and monitoring

Urgent actions

17) Where possible, commercial fisheries and research programs involving capture/handling of sawfish to include tissue collection for contribution to the national CKMR estimates (action 24).

Medium-term actions

18) Develop an overarching research and monitoring plan for the largetooth sawfish including performance indicators, monitoring mechanisms and timeframes, and a process for ongoing review of the plan. This plan should be developed in collaboration with key stakeholders such as commercial and recreational fisheries that interact with the species, researchers, and Traditional Owners/Custodians.

19) Continue to cultivate collaborative work between (and among) researchers, managers, and commercial fishers to refine and improve sawfish data collection methods, processes, and analyses. This should include collaborative fishery-independent survey efforts to fill key data gaps and enable robust estimation of largetooth sawfish population size and trend within Australian waters.

20) Undertake surveys to determine the occurrence and relative abundance of largetooth sawfish where there is very limited data, such as the eastern side of Cape York.

21) Establish a reporting mechanism and database for largetooth sawfish interactions in recreational fisheries.

    a) Encourage and educate recreational fishers to identify sawfishes to species level and to report all interactions. These data will inform estimation of the level of interaction with, and mortality of largetooth sawfish in recreational fisheries.

Information and research

Urgent actions

22) Test and implement methods to reduce interaction rates in commercial fisheries (e.g., LED lights attached to fishing gear).

23) Estimate levels of capture/handling stress and post-release mortality in commercial and recreational fisheries, and test methods to reduce mortality associated with interactions.

Medium-term actions

24) Use CKMR techniques (e.g., NESP project 3.11) or other techniques, and in conjunction with information on age and spatial population structure, to estimate largetooth sawfish population abundance and trend, mortality and fecundity.

    a) Within 6 months of the conclusion of the population analyses (action 24), independent quantitative analyses should be undertaken to improve understanding of population status, quantify the impact of ongoing threats and the efficacy of various management actions, and to identify additional measures needed to recover the species. It is anticipated that these subsequent analyses will determine whether estimates of total fishing mortality are contributing to ongoing decline or inhibiting recovery of the species.

25) Investigate the implications of cumulative threats aside from fishing mortality, including habitat degradation and climate change.

26) Develop predictive, integrative models to quantify and predict the likely climate-related impacts to the population trajectories of the species including:

a) The significance of sea temperature rise and marine heatwaves on known nursery areas, aggregation sites, and important habitat for the largetooth sawfish within Australia.

b) The potential for distributional shifts to result in increased interactions with fisheries that have not historically interacted with large numbers of the species.

c) Changes to, or contraction of, important habitat (e.g., known nursery areas or aggregation sites).

d) Effects of range shifts in known prey species.

27) Improve the prediction capability for extreme environmental events to enable possible management responses (such as responsive management of water abstraction practices) to alleviate extreme detrimental conditions within sawfish habitats.

28) Determine the natality of largetooth sawfish in Australia, coupled with methods to estimate population sizes, to support future PVA (e.g., Grant 2022).

29) Use all available information to delineate important habitat for the largetooth sawfish.

30) Quantify the impact of illegal, unregulated and unreported fishing on largetooth sawfish.

31) Determine the utility of molecular monitoring (e.g., Green et al. 2024) as an additional monitoring tool to validate catch data and assess the sustainability of commercial fisheries. For example, undertake trials of molecular monitoring during trawl activities and during sorting (Green et al. 2024; Maiello et al. 2022).

32) Refine and implement techniques (including genetic and morphological) to identify sawfish products.

33) Quantify recruitment and survival in freshwater environments, including investigation of the prevalence and impact of crocodile predation upon largetooth sawfish (Grant 2022).

34) Determine the implications of climate change for the ability of largetooth sawfish to recruit into their nursery and survive successive dry seasons, and determine whether there are water management or other measures that may mitigate the impact.

Links to relevant implementation documents

- Sawfish and River Sharks Multispecies Recovery Plan: (*Pristis pristis, Pristis zijsron, Pristis clavata, Glyphis glyphis* and *Glyphis garricki*)
- Non detriment finding for the Freshwater Sawfish, *Pristis microdon*
- *Pristis pristis* species profile: Memorandum of Understanding on the Conservation of Migratory Sharks
- Australia's Second National Plan of Action for the Conservation and Management of Sharks 2012 (Shark-plan 2)

Conservation Advice and Listing Assessment references

AFMA (Australian Fisheries Management Authority) (2023) *International Compliance and Engagement Program 2022-2024*. Australian Fisheries Management Authority. Available at: https://www.afma.gov.au/sites/default/files/2023-02/afma_international_compliance_and_engagement_program_2022-24_tagged.pdf

Barber M & Woodward E (2018) *Indigenous water values, rights, interests and development objectives in the Fitzroy catchment*. A technical report to the Australian Government from the CSIRO Northern Australia Water Resource Assessment, part of the National Water Infrastructure Development Fund: Water Resource Assessments. CSIRO, Australia.Buckley KA, Crook DA, Einoder LD, Pillans RD, Smith LD & Kyne PM (2020) Movement behaviours and survival of largetooth sawfish, *Pristis pristis*, released from a public aquarium. *Aquatic Conservation: Marine and Freshwater Ecosystems* 30, 2351–2369.

Buckley KA, Crook DA, Pillans RD, Smith L & Kyne PM (2018) Sustainability of threatened species displayed in public aquaria, with a case study of Australian sharks and rays. *Reviews in Fish Biology and Fisheries* 28, 137–151.

Buckley, KA, Smith, LD, Crook, DA, Pillans, RD and Kyne, PM (2020) Conservation impact scores identify shortfalls in demonstrating the benefits of threatened wildlife displays in zoos and aquaria. *Journal of Sustainable Tourism* 28, 978–1002.

Chidlow JA (2007) First record of the freshwater sawfish, *Pristis microdon*, from southwestern Australian waters. *Records of the Western Australian Museum* 23, 307–308.

Chin A, Kyne PM, Walker TI & Mcauley RB (2010) An integrated risk assessment for climate change: analysing the vulnerability of sharks and rays on Australia's Great Barrier Reef. *Global Change Biology* 16,1936–1953.

Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2018) *Water resource assessment for the Darwin catchments*. CSIRO Northern Australia Water Resource Assessment. CSIRO, Australia.

Department of the Environment (DOE)(2015a) *Sawfish and River Sharks Multispecies Recovery Plan*. Commonwealth of Australia.

Department of the Environment (DOE)(2015b) *Sawfish and River Sharks Multispecies Issues Paper*. Commonwealth of Australia.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2011) *Non detriment finding for the Freshwater Sawfish, Pristis microdon*. Commonwealth of Australia.

Devitt KR, Adams VM & Kyne PM (2015) Australia's protected area network fails to adequately protect the world's most threatened marine fishes. *Global Ecology and Conservation* 3, 401–411.

Doupé RG, Morgan DL & Gill HS (2005) Prospects for a restorative fishery enhancement of Lake Kununurra: a high-level tropical impoundment on the Ord River, Western Australia. *Pacific Conservation Biology* 11, 36–146.

Dulvy NK, Davidson LN, Kyne PM, Simpfendorfer CA, Harrison LR, Carlson JK & Fordham SV (2016) Ghosts of the coast: global extinction risk and conservation of sawfishes. *Aquatic Conservation: Marine and Freshwater Ecosystems* 26, 134–153.

Dulvy NK, Fowler SL, Musick JA, Cavanagh RD, Kyne PM, Harrison LR, Carlson JK, Davidson LN, Fordham SV, Francis MP & Pollock CM (2014) Extinction risk and conservation of the world's sharks and rays. *eLife* 3, e00590.

Espinoza M, Bonfil-Sanders R, Carlson J, Charvet P, Chevis M, Dulvy NK, Everett B, Faria V, Ferretti F, Fordham S, Grant MI, Haque AB, Harry AV, Jabado RW, Jones GCA, Kelez S, Lear KO, Morgan DL, Phillips NM & Wueringer BE (2022) *Pristis pristis*. The IUCN Red List of Threatened Species 2022: e.T18584848A58336780.

Faria VV, McDavitt MT, Charvet P, Wiley TR, Simpfendorfer CA & Naylor GJ (2013) Species delineation and global population structure of Critically Endangered sawfishes (Pristidae). *Zoological Journal of the Linnean Society* 167, 136–164.

Feutry P, Kyne PM, Pillans RD, Chen X, Marthick JR, Morgan DL & Grewe PM (2015) Whole mitogenome sequencing refines population structure of the Critically Endangered sawfish *Pristis pristis. Marine Ecology Progress Series* 533, 237–244.

Field IC, Charters R, Buckworth RC, Meekan MG & Bradshaw C (2008) *Distribution and abundance of Glyphis and sawfishes in northern Australia and their potential interactions with commercial fisheries*. Department of the Environment, Water, Heritage and the Arts, Commonwealth of Australia.

Field IC, Meekan MG, Buckworth RC & Bradshaw CJ (2009) Protein mining the world's oceans: Australasia as an example of illegal expansion-and-displacement fishing. *Fish and Fisheries* 10, 323–328.

Field IC, Tillett BJ, Charters R, Johnson GJ, Buckworth RC, Meekan MG & Bradshaw CJ (2013) Distribution, relative abundance and risks from fisheries to threatened Glyphis sharks and sawfishes in northern Australia. *Endangered Species Research* 21, 171–180.

Fukuda Y, Webb G, Manolis C, Delaney R, Letnic M, Lindner G & Whitehead P (2011) Recovery of saltwater crocodiles following unregulated hunting in tidal rivers of the Northern Territory. *Australia The Journal of Wildlife Management* 75, 1253–1266.

Gelsleichter J, Walsh CJ, Szabo NJ & Rasmussen LE (2006) Organochlorine concentrations, reproductive physiology, and immune function in unique populations of freshwater Atlantic stingrays (*Dasyatis sabina*) from Florida's St Johns River. *Chemosphere* 63, 1506–1522.

Giles J, Pillans R, Miller M & Salini J (2002) *Sawfish catch data in northern Australia: a desktop study*. Final Report to the Fisheries Research and Development Corporation (FRDC), Canberra.

Government of Western Australia (WA) (2020) *Managing water in the Fitzroy River Catchment*. Discussion paper for stakeholder consultation.

Grant MI (2022) *Conservation of non-marine elasmobranchs*. Doctoral thesis, James Cook University, Townsville. Available at https://researchonlinejcueduau/75533/.

Green ME, Hardesty BD, Deagle BE & Wilcox C (2024). Environmental DNA as a tool to reconstruct catch composition for longline fisheries vessels. *Scientific reports* 14, p.10188.

Harry AV, Wakefield CB, Newman SJ & Braccini JM (2024) Trends in catch rates of sawfish on the Australian North West Shelf. *Endangered Species Research* 53, 23-33.

Harrison LR & Dulvy NK (eds) (2014) *Sawfish: A Global Strategy for Conservation*. The IUCN Shark Specialist Group (SSG).

Heupel MR, Kyne PM, White WT & Simpfendorfer CA (2018) *Shark Action Plan Policy Report*. Report to the National Environmental Science Program, Marine Biodiversity Hub. Australian Institute of Marine Science.

Hueter RE, Heupel MR, Heist KJ & Kneey DB (2004) Evidence of philopatry in sharks and implications for the management of shark fisheries. *Journal of Northwest Atlantic Fishery Science* 35, 239–247.

IUCN Standards and Petitions Committee (2012) *Guidelines for application of IUCN Red List Criteria at regional and national levels*, Version 4.0. Prepared by the Standards and Petitions Committee, IUCN, Gland, Switzerland and Cambridge, United Kingdom.

IUCN Standards and Petitions Committee (2019) *Guidelines for using the IUCN Red List Categories and Criteria*, Version 14. Prepared by the Standards and Petitions Committee, IUCN, Gland, Switzerland and Cambridge, United Kingdom.

IUCN Standards and Petitions Committee (2024) *Guidelines for Using the IUCN Red List Categories and Criteria*. Version 16. Prepared by the Standards and Petitions Committee. Downloadable from https://www.iucnredlist.org/documents/RedListGuidelines.pdf.

Jacobsen I, Walton L & Lawson A (2021) *East Coast Inshore Large Mesh Net Fishery Level 2 ecological risk assessment (Species of Conservation Concern)*. State of Queensland, Brisbane. Available at https: //era.daf.qld. gov.au/id/eprint/8107/.

Jacobsen I, Walton L & Zeller B (2019) *East Coast Inshore Fin Fish Fishery Level 1 ERA – whole of fishery assessment*. State of Queensland, Brisbane. Available at http: //era.daf.qld.gov.au/id/eprint/6969/.

Kyne PM, Brooke B, Davies CL, Ferreira L, Finucci B, Lymburner L, Phillips C, Thums M & Tulloch V (2018) *Scoping a Seascape Approach to Managing and Recovering Northern Australian Threatened and Migratory Marine Species*. Report to the National Environmental Science Programme, Marine Biodiversity Hub. Charles Darwin University, Darwin.

Kyne PM, Carlson J, & Smith K (2013). *Pristis pristis* (errata version published in 2019). The IUCN Red List of Threatened Species 2013: e.T18584848A141788242. Available at http://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T18584848A141788242.en.

Kyne PM, Heupel MR, White WT & Simpfendorfer CA (2021b) *The Action Plan for Australian Sharks and Rays 2021*. National Environmental Science Program, Marine Biodiversity Hub, Hobart.

Kyne PM, Oetinger M, Grant MI & Feutry P (2021a) Life history of the Critically Endangered largetooth sawfish: a compilation of data for population assessment and demographic modelling. *Endangered Species Research* 44, 79–88.

Lack M (2010) *Assessment of risks that commercial fishing methods may pose to conservation values identified in the areas for further assessment of the north and north-west marine regions*, Shellack Pty Ltd.

Lack M & Sant (2008) *Illegal, unreported and unregulated shark catch: A review of current knowledge and action*. Department of the Environment, Water, Heritage and the Arts and TRAFFIC, Canberra.

Last PR & Stevens JD (2009) *Sharks and Rays of Australia.* CSIRO Publishing, Hobart.

Last PR, White W, Carvalho M, Séret B, Stehmann M & Naylor G (eds) (2016) *Rays of the World.* CSIRO Publishing, Collingwood.

Lear KO, Ebner BC, Fazeldean T, Bateman RL & Morgan DL (2024) Effects of coastal development on sawfish movements and the need for marine animal crossing solutions. Conservation Biology, p.e14263.

Lear KO, Gleiss AC, Whitty JM, Fazeldean T, Albert JR, Green N, Ebner BC, Thorburn DC, Beatty SJ & Morgan DL (2019) Recruitment of a critically endangered sawfish into a riverine nursery depends on natural flow regimes. *Scientific reports* 9, p17071.

Lear KO, Morgan DL, Whitty JM, Beatty SJ & Gleiss AC (2021) Wet season flood magnitude drives resilience to dry season drought of a euryhaline elasmobranch in a dry-land river. *Science of the Total Environment* 750, p142234.

Lear KO, Morgan DL, Whitty JM, Whitney NM, Byrnes EE, Beatty SJ & Gleiss AC (2020) Divergent field metabolic rates highlight the challenges of increasing temperatures and energy limitation in aquatic ectotherms. *Oecologia* 193, 311–323.

Leigh GM (2015) *Stock assessment of whaler and hammerhead sharks (Carcharhinidae and Sphyrnidae) in Queensland*. Queensland Department of Agriculture and Fisheries, Brisbane.

Maiello G, Talarico L, Carpentieri P, De Angelis F, Franceschini S, Harper LR, Neave EF, Rickards O, Sbrana A, Shum P & Veltre V (2022) Little samplers, big fleet: eDNA metabarcoding from commercial trawlers enhances ocean monitoring. *Fisheries Research* 249, 106259.

Marshall L (2011) *The Fin Blue Line. Quantifying Fishing Mortality Using Shark Fin Morphology*. PhD Thesis, University of Tasmania, Hobart.

McAuley R, Lenanton R, Chidlow J, Allison R & Heist E (2005) *Biology and stock assessment of the thickskin (sandbar) shark, Carcharhinus plumbeus, in Western Australia and further refinement of the dusky shark, Carcharhinus obscurus*. Final FRDC Report – Project 2000/134, Fisheries Research Report No 151, Department of Fisheries, Western Australia.

McDavitt MT (2005) *The cultural significance of sharks and rays in Aboriginal societies across Australia's top end*. Marine Education Society of Australasia, Canberra.

Moreno DA (2012) *Demography of the family Pristidae as an aid to conservation and management.* Bachelor of Marine Science (Honours) thesis, James Cook University, Townsville.

Morgan DL, Somaweera R, Gleiss AC, Beatty SJ & Whitty JM (2017) An upstream migration fought with danger: freshwater sawfish fending off sharks and crocodiles. *Ecology* 98, 1465–1467.

Morgan D, Thorburn D, Fenton J, Wallace-Smith H & Goodson S (2005) *Influence of the Camballin Barrage on fish communities in the Fitzroy River, Western Australia*. Murdoch University, Kimberley Land Council & Department of Environment report to Land and Water Australia.

Musick JA, Burgess G, Cailliet G, Camhi M & Fordham S (2000) Management of sharks and their relatives (Elasmobranchii). *Fisheries* 25, 9–13.

National Environmental Science Program (NESP) Earth Systems and Climate Change Hub (2020) *Climate change in the Northern Territory: State of the science and climate change impacts*. NESP ESCC Hub, Melbourne.

Northern Territory Government (2024) Northern Territory Offshore Net and Line Fishery: Ecological Risk Assessment. In review.

Pascoe S, Okey TA & Griffiths S (2008) Economic and ecosystem impacts of illegal, unregulated and unreported (IUU) fishing in Northern Australia. *Australian Journal of Agricultural and Resource Economics* 52, 433–452.

Patterson H, Larcombe J, Woodhams J & Curtotti R (2020) *Fishery status reports 2020.* Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra CC BY 40. Available at https://doiorg/1025814/5f447487e6749.

Patterson TA, Pillans RD & Donovan A (2022) *Analysis of CPUE trends in Australian Sawfish from research data 2000-2021*. Report to Department of Agriculture Water and Environment, CSIRO Oceans and Atmosphere, Hobart.

Petheram C, Bruce C, Chilcott C & Watson I (eds) (2018) *Water resource assessment for the Fitzroy catchment*. A report to the Australian Government from the CSIRO Northern Australia Water Resource Assessment, CSIRO, Australia.

Peverell SC (2005) Distribution of sawfishes (Pristidae) in the Queensland Gulf of Carpentaria, Australia, with notes on sawfish ecology. *Environmental Biology of Fishes* 73, 391–402.

Peverell SC (2010) *Sawfish (Pristidae) of the Gulf of Carpentaria, Queensland, Australia*. Masters thesis, James Cook University, Townsville.

Phillips NM, Chaplin JA, Morgan DL & Peverell SC (2011) Population genetic structure and genetic diversity of three critically endangered Pristis sawfishes in Australian waters. *Marine Biology* 158, 903–915.

Pillans RD, Hillary R, Patterson T (2021) *Assessing the effect of ongoing bycatch of sawfish in northern Australia*. Report to Department of Agriculture Water and Environment. CSIRO Oceans and Atmosphere, Hobart.

Pillans R, Patterson T & Donovan A (2022) *Sawfish bycatch mitigation workshop for northern Australian fisheries*. Report to the Reef and Rainforest Research Centre, Cairns, Queensland. CSIRO Oceans and Atmosphere, Hobart.

Plagányi E, Kenyon R, Blamey L, Burford M, Robins J, Jarrett A, Laird A, HughesJ, Kim S, Hutton T, Pillans R, Deng R, Cannard T, Lawrence E, Miller M & Moeseneder C (2022) *Ecological modelling of the impacts of water development in the Gulf of Carpentaria with particular reference to impacts on the Northern Prawn Fishery.* Final Report to the Fisheries Research and Development Corporation (FRDC), Canberra.

Runge MC (2011) An introduction to adaptive management for threatened and endangered species. *Journal of Fish and Wildlife Management* 2, 220–233.

Salini J, McAuley R, Blaber S, Buckworth R, Chidlow J, Gribble N, Ovenden J, Peverell S, Pillans R & Stevens J (2007) *Northern Australian sharks and rays: the sustainability of target and bycatch species, phase 2*, Project No 2002/064. Fisheries Research and Development Corporation and CSIRO Marine and Atmospheric Research, Australia.

Simpfendorfer C, Chin A, Kyne P, Rigby C, Sherman S & White W (2019) *Pristis pristis* profile. In: *Shark futures: a report card for Australia's sharks and rays*. Centre for Sustainable Tropical Fisheries and Aquaculture, James Cook University, Townsville.

Stevens JD, McAuley RB, Simpfendorfer CA & Pillans RD (2008) *Spatial distribution and habitat utilisation of sawfish (Pristis spp.) in relation to fishing in northern Australia*. A report to the Department of the Environment, Water, Heritage and the Arts, CSIRO.

Stevens JD, Pillans RD, & Salini J (2005) *Conservation assessment of Glyphis sp. A (speartooth shark), Glyphis sp. C (northern river shark), Pristis microdon (freshwater sawfish) and Pristis zijsron (green sawfish)*. CSIRO Marine Research, Australia.

Thorburn DC, Morgan DL, Rowland AJ & Gill H (2004a) *Elasmobranchs in the Fitzroy River, Western Australia*. Australian Department of Environment and Heritage, Canberra.

Thorburn DC, Peverell S, Stevens JD, Last PR & Rowland AJ (2004b) *Status of freshwater and estuarine elasmobranchs in northern Australia*, Murdoch University, Perth.

Thorburn DC, Morgan DL, Rowland AJ & Gill HS (2007) Freshwater sawfish *Pristis microdon* Latham, 1794 (Chondrichthyes: Pristidae) in the Kimberley region of western Australia. *Zootaxa* 1471, 27–41.

Thorburn DC, Gill HS & Morgan DL (2014) Predator and prey interactions of fishes of a tropical Western Australia river revealed by dietary and stable isotope analyses. *Journal of the Royal Society of Western Australia* 97, 363–388.

Trenberth KE, Dai A, Van Der Schrier G, Jones PD, Barichivich J, Briffa KR & Sheffield J (2014) Global warming and changes in drought. *Nature Climate Change* 4, 17–22.

Udyawer V, Stacey N, Buccella C, Streten C, Harries S, Hammond M, English D & Winchester K (2024) *Tapping into the knowledge of professional fishers to inform research and management of Sawfish and River Sharks.* Report prepared for Parks Australia. Northern Territory Seafood Council, Australian Institute of Marine Science, Charles Darwin University, Darwin.

Udyawer V, Thums M, Ferriera L, Tulloch V & Kyne P (2021) *Seascape approach to managing and recovering northern Australian threatened and migratory marine species*. Report to the National Environmental Science Program, Marine Biodiversity Hub.

Whitty, JM Morgan, DL & Thorburn DC (2009) Movements and interannual variation in the morphology and demographics of freshwater sawfish (*Pristis microdon*) in the Fitzroy River. In: Phillips NM, Whitty JM, Morgan DL, Chaplin JA, Thorburn DC, & Peverell SC (eds) *Freshwater sawfish (Pristis microdon) movements and demographics in the Fitzroy River, Western Australia and genetic analysis of P. microdon and Pristis zijsron.* Centre for Fish & Fisheries Research, Murdoch University, Perth.

Wiley TR & Simpfendorfer CA (2010) Using public encounter data to direct recovery efforts for the endangered smalltooth sawfish *Pristis pectinata. Endangered Species Research* 12, 179–191.

Wueringer BE (2017) Sawfish captures in the Queensland shark control program, 1962 to 2016. *Endangered Species Research* 34, 293–300.

Wueringer BE, Biskis VN & Pinkus GA (2023) Impacts of trophy collection and commercial fisheries on sawfishes in Queensland, Australia. *Endangered Species Research* 50, 133–150.

Wueringer BE, Peverell SC, Seymour J, Squire Jr L, Kajiura SM & Collin SP (2011) Sensory systems in sawfishes: 1 The *ampullae of Lorenzini*. *Brain Behavior and Evolution* 78, 139–149.

Yan HF, Kyne PM, Jabado RW, Leeney RH, Davidson LN, Derrick DH, Finucci B, Freckleton RP, Fordham SV & Dulvy NK (2021) Overfishing and habitat loss drive range contraction of iconic marine fishes to near extinction. *Science Advances* 7, eabb6026.

Yates PM, Heupel MR, Tobin AJ & Simpfendorfer CA (2012) Diversity in young shark habitats provides the potential for portfolio effects. *Marine Ecology Progress Series* 458, 269–281.

Zhou S, Daley RM, Fuller M, Bulman CM & Hobday AJ (2019) A data-limited method for assessing cumulative fishing risk on bycatch. *ICES Journal of Marine Science* 76, 837–847.

Zhou S & Griffiths SP (2008) Sustainability Assessment for Fishing Effects (SAFE): A new quantitative ecological risk assessment method and its application to elasmobranch bycatch in an Australian trawl fishery. *Fisheries Research* 91, 56–68.

Zinke L (2020) The colours of carbon. *Nature Reviews: Earth & Environment* 1, 141.

Other sources

Harry A (2023). Unpublished data, 22 March 2023. Research Scientist, Western Australia Department of Primary Industries and Regional Development.

Pillans R (2024). Unpublished data, 08 May 2024. Researcher, Commonwealth Scientific and Industrial Research Organisation, Australia.

The Threatened Species Scientific Committee finalised this assessment on DD Month Year.

Attachment A: Listing Assessment for *Pristis pristis*

Reason for assessment

This assessment follows prioritisation of a nomination for uplisting from the public.

The largetooth sawfish was listed by a previous name (*Pristis microdon*; freshwater sawfish) under the *Endangered Species Protection Act 1992* and transferred to the Vulnerable category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) when it commenced in July 2000. The species was relisted under its new name (*Pristis pristis*; largetooth sawfish) on the threatened species list established under the EPBC Act on 3 October 2013.

Assessment of eligibility for listing

This assessment uses the criteria set out in the EPBC Regulations. The thresholds used correspond with those in the IUCN Red List criteria except where noted in criterion 4, sub-criterion D2. The IUCN criteria are used by Australian jurisdictions to achieve consistent listing assessments through the Common Assessment Method (CAM).

Key assessment parameters

Table 3 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria. The definition of each of the parameters follows the Guidelines for Using the IUCN Red List Categories and Criteria.

Table 2: Key assessment parameters

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	Possibly <10,000			Reported in Kyne et al. (2021a) with 'low reliability'.
Trend	Declining			Reported in Kyne et al. (2021a) with 'medium reliability'.
Generation time (years)	22	14.6		**Estimate used:** Reported in Kyne et al. (2021b) with 'high reliability'. This estimate is based on species-specific age data from the GOC (age-at-maturity = 8 years, maximum age = 35 years; Peverell 2009; Kyne et al. 2021b) Generation length was calculated by Kyne et al. (2021b) as the median age of parents of the current cohort as: [(maximum age – age-at-maturity)/2)] + age-at-maturity **Minimum plausible value:** Moreno (2012) estimated generation length as 14.6 years using demographic models with a maximum age of 35 years and age-at-maturity of 6 years.
Extent of occurrence	2 274 800 km^2	1 203 565 km^2		**Estimate used:** Reported in Kyne et al. (2021a) with 'high reliability'. **Minimum plausible value:** Calculated by Devitt et al. (2015) using records obtained from Commonwealth and state/territory fisheries departments, museums, literature, and expert consultation. EOO was calculated as the area of a convex polygon encompassing verified species-specific occurrence records (excluding vagrants off southwestern Australia; Chidlow, 2007) which were clipped to include only (1) the potential range within Australia's Exclusive Economic Zone and (2) only water bodies within 400 km inland of coastal waters. Hence this approach varies from the method used by the IUCN Red List of Threatened Species.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Unknown			Reported in Kyne et al. (2021a) with 'low reliability'
Area of Occupancy[1]	>2 000 km^2		895 617 km^2	**Estimate used:** Reported in Kyne et al. (2021a) with 'low reliability'. Given the sparsity of survey effort across the species' Australian range, calculating AOO by intersection of a 2 km x 2km grid with only the spatial coordinates of known occurrences very likely underestimates the area of occupied habitat. **Maximum plausible value:** Calculated by Devitt et al. (2015) using occurrence records as well as the distribution of suitable habitat. A line shapefile of streams was modified into polygons by buffering lines to 200 m total. This estimate is based on polygon area rather than 2 km x 2 km grid. It also represents an upper limit because not all areas with suitable habitat may be occupied by the species. There is insufficient data to estimate the proportion of potential habitat that is occupied at the time of this assessment.
Trend	Unknown			Reported in Kyne et al. (2021a) with 'low reliability'.
Number of subpopulations	> 5			Reported in Kyne et al. (2021a) with 'high reliability'.
Trend	Unknown			
Basis of assessment of subpopulation number	Whole mitochondrial sequences revealed barriers to gene flow at a scale as fine as between adjacent river drainages. These results suggest that each river drainage across the species' range should be considered a discrete management unit unless there is evidence of freshwater connectivity (Feutry et al. 2015).			
No locations	> 10			Reported in Kyne et al. (2021a) with 'high reliability'.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Unknown			
Basis of assessment of location number	Expert opinion published in Kyne et al. (2021a). The term 'location' defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present (IUCN Standards and Petitions Committee 2024). Fishing mortality is the most plausible threat to the species in Australian waters, and the numerous commercial fisheries, gears and sectors (Table 1) are considered as potential agents of 'a single threatening event', the impact of which is likely to vary between areas (e.g., between river systems to which the species exhibits reproductive philopatry).			
Fragmentation	Not severely fragmented. A taxon can be considered to be severely fragmented if most (> 50%) of its total area of occupancy is in habitat patches that are (1) smaller than would be required to support a viable population, and (2) separated from other habitat patches by a large distance (IUCN Standards and Petitions Committee 2024). In this instance, river systems with females exhibiting reproductive philopatry are treated as habitat patches. Largetooth Sawfish is a mobile bentho-pelagic species and tag-recapture data indicate movements of up to 220 km between capture locations (sex unspecified, Peverell 2009). Hence most subpopulations are not isolated by distances 'several times greater' than the species' dispersal distance (IUCN Standards and Petitions Committee 2024). Northern and eastern Australia provides large stretches of contiguous coastal and estuarine habitats that are not separated by vast distances. However, reproductive philopatry in females (Phillips et al. 2011) indicates that females probably have limited capacity to transition between patches (i.e., river systems) for the purpose of reproduction.			
Fluctuations	Insufficient data. Lear et al. (2019) used standardised fisheries-independent catch data collected over 17 years to investigate the relationship between wet season volume and recruitment of largetooth sawfish into the Fitzroy River, WA, nursery. Annual catch-per-unit-effort for young-of-the-year (YOY) individuals in freshwater environments varied by more than order of magnitude; ranging from 0.008–0.45 sawfish 20-m net^{-1} hr^{-1} (Figure 3 in Lear et al. 2019). However, the relationship between annual YOY abundance in freshwater environments and population size as defined by the IUCN Red List (i.e., number of mature individuals only; IUCN Standards and Petitions Committee 2024) is unknown. For instance, no relationship between CPUE in estuarine habitats and wet season volume was detected, suggesting that largetooth sawfish are pupped and may reach macrotidal estuarine environments regardless of the magnitude of flooding (Lear et al. 2019). Assessment of the occurrence of extreme fluctuations based on these results is further complicated by uncertainty in natural and anthropogenic mortality across life-history stages and habitat types.			

[1] AOO is a standardised spatial measure of the risk of extinction, that represents the area of suitable habitat known, inferred or projected to be currently occupied by the taxon. It is estimated using a 2 x 2 km grid to enable comparison with the criteria thresholds. The resolution (grid size) that maximizes the correlation between AOO and extinction risk is determined more by the spatial scale of threats than by the spatial scale at which AOO is estimated or shape of the taxon's distribution. It is not a fine-scale estimate of the actual area occupies. In some cases, AOO is the smallest area essential at any stage to the survival of existing populations of a taxon (e.g. breeding sites for migratory species). For further information see IUCN Standards and Petitions Committee (2019).

Criterion 1 Population size reduction (*IUCN Criterion A*)

Reduction in total numbers (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered **Very severe reduction**	**Endangered** **Severe reduction**	**Vulnerable** **Substantial reduction**
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected, inferred or suspected to be met in the future (up to a maximum of 100 years) [*(a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

Based on any of the following

(a) direct observation [except A3]
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Source: IUCN Red List Criteria used to evaluate if taxon is eligible to be included in a IUCN Red List threatened category (Critically Endangered, Endangered or Vulnerable).

Criterion 1 evidence

Eligible under Criterion 1 A2bd for listing as Endangered

While Australia still has viable subpopulations of largetooth sawfish in some parts of the species' range, the Committee considers that these have undoubtedly undergone substantial decline based on the species' known vulnerability to the threats outlined in Table 1 and extirpations across parts of its former range. Estimating the magnitude of population size reduction in Australian waters is hindered by the scarcity of reliable species-specific data. Most notably, it is not possible to use commercial logbooks as a direct means of estimating sawfish catch in any fishery in northern Australia (Pillans et al. 2021). Notwithstanding these challenges, the following sections provide an overview of the Committee's inferences, which are based on a variety of information sources.

The primary cause of population size reduction of largetooth sawfish in Australian waters is capture as bycatch in commercial fisheries managed by Qld, NT and the Commonwealth (Table 1). While management measures for the species are now in place in Australia, including species protection under the EPBC Act, education available for fishers regarding best handling practices, and fisheries-specific management, there is no evidence to suggest that the ongoing catches are sustainable or that the impact of fishing mortality on the species is sustainable or decreasing.

Empirical estimates of decline

Plagányi et al. (2022) used a spatial, age-structured MICE (Models of Intermediate Complexity for Ecosystem assessments) ecosystem modelling approach to estimate a time series of relative abundance for largetooth sawfish within rivers of the GOC during years 1970–2020. The models used fishing effort data from the NPF trawl and Qld- and NT-managed gillnet fisheries. The results of the base case model ensemble, while highly uncertain due to the lack of historical data, uniformly supported large population size reductions in all catchments (Table 3) and predict that the species' recovery is likely to be slow. The authors also emphasised the need for improved information on the species' abundance and life history (Plagányi et al. 2022).

The Committee considered the following limitations when interpreting the results of the MICE models in Plagányi et al. (2022):

- No suitable time-series data were available with which to validate model predictions. Therefore, the models were bounded only by plausibility and current life history data. Results were explored across a wide range of alternative parametrisations to explore the potential implications of this data scarcity on the conclusions.
- Natural mortality remains uncertain and had a large impact on modelling results.
- Post-release survival was assumed to be zero *in lieu* of data.
- Scarce data were available with which to quantify the influence of river flow on largetooth sawfish population dynamics (except for Lear et al. 2019).
- Models did not account for potential negative impacts of barrages or dams, which obstruct the free movement of sawfish along river systems.
- Models did not include mortality of immature sawfish from predation by crocodiles, noting that sawfish can be especially susceptible to being preyed upon when they are obstructed by barriers to upstream movement.

Given these caveats, the Committee considers that the results in Table 3 cannot be used for quantitative evaluation against Criterion 1. However, given that 92% of the estimated declines in Table 3 were ≥ 80%, and the study period (1970–2020) falls within the past three generations (1957 to 2023), these results provide no indication that the magnitude of population decline in Australian waters is less than 80%. Albeit being of low confidence for the purposes of this listing assessment, these results increase the Committee's strength of inference when considered in conjunction with the other lines of information presented under Criterion 1.

Table 3: Summary of MICE ensemble current depletion levels (calculated from Table 14 in Plagányi et al. 2022). Numbers are the percentage reduction in the number of mature largetooth sawfish in each river catchment between years 1970 and 2020. The five different models were intended to capture a broad range of plausible depletion scenarios (see footnote).

Model	Percentage depletion				
	Mitchell River	Gilbert River	Norman River	Flinders River	Roper River
Model 1	91	88	96	94	95
Model 2	90	92	88	91	93
Model 3	55	81	96	94	95
Model 4	55	81	96	94	95
Model 5	83	96	96	82	95

Model 1: Starting biomass tuned so sawfish currently heavily depleted as considered plausible; Model 2: Flow relationship parameters changed; Model 3: Larger natural mortality (M) assumed for sawfish but also higher juvenile survival and higher average pups per year; Model 4: Started with different number of sawfish in population, so current depletion estimates different; Model 5: Larger boom-bust dynamics (06-14) and change in threshold parameter (see Plagányi et al. (2022) for details).

Population Viability Analyses

Grant (2022) used Population Viability Analysis (PVA) to determine the recovery potential of largetooth sawfish under various threat scenarios across northern Australia. Resulting population trajectories indicated that the status of largetooth sawfish varies across the species' northern Australian range. The magnitudes of decline were generally larger in Qld and NT compared to WA, which was largely a reflection of differences in commercial fishing effort between jurisdictions. The status of the species also varied between models within jurisdictions due to uncertainty in natality and fishing pressure. Overall, the level of uncertainty in model parameters made it difficult to determine high confidence estimates of the magnitude of population decline. Hence these results were not used for quantitative assessment under Criterion 1. However, the models demonstrated that ongoing threats, principally mortality in commercial fisheries (Table 1), are likely to drive further decline and inhibit recovery of the species.

The Committee considers that the PVA models in Grant (2022) do not provide any evidence to suggest that the magnitude of population size reduction during the past three generations has been < 80%. In some plausible modelled scenarios, which assumed, *inter alia*, (1) that the true number of interactions was double the number of reported interactions, and (2) no future increases in fishing effort, maximum population size reduction over the future three generations was > 80%. Given that extrapolation of present fishing effort three generations into the future led to a conservative future population reduction of > 80%, and that historical fishing effort has been higher than present levels (Table 1), the Committee considers that the true magnitude of population size decline over the past three generations could have been even higher than 80%.

Fisheries-dependent data

Pillans et al. (2021) compiled available fisheries data and life history parameters for largetooth sawfish in Australian waters. Attempts to determine the status of the species in Australian waters were hindered by the limited and unreliable data from commercial fisheries. In particular, the levels of interactions reported in commercial logbooks were significantly lower than the number of sawfish reported by observers. Hence it was not possible to use commercial

logbooks as a direct means of estimating sawfish catch in any fishery in northern Australia Fisheries-dependent data were also insufficient to reliably estimate current population size/status, unexploited population size in Australia or the magnitude of population decline in Australia (Pillans et al. 2021).

When extrapolating based on effort records, total largetooth sawfish catches ranged from 166–273 individuals per year during years 2007–2016. Pillans et al. (2021) caution that stability in total catches across years was likely driven by unavoidable extrapolation from effort records alone. Therefore, these estimates were reported with low confidence.

Given the observed levels of decline and extirpations outside of Australian waters (Dulvy et al. 2016), Pillans et al. (2021) considered it reasonable to assume that the Australian population of largetooth sawfish is located somewhere between maximum sustainable yield (MSY) and crash state (i.e., where fishing mortality exceeds MSY and leads to the population becoming extinct). Pillans et al. (2021) combined all available life-history data with the estimated catch data (numbers and length compositions) to estimate the rates of fishing mortality at which MSY and crash state would be reached. Pillans et al. (2021) emphasised that the analyses were unavoidably compromised by very limited data on historical and contemporary catches, and multiple aspects of the species' biology.

When assuming that fisheries mortality during 2010–2016 was at MSY, the estimated population size required to support such catches was 4272 individuals (95% credible interval = 3062–5642 individuals). When assuming that fisheries mortality was at crash point, total abundance was estimated to be 1064 individuals (95% credible interval = 763–1405 individuals). The estimated catches were approximately 5% and 20% of MSY and crash point, respectively. Pillans et al. (2021) reported that these estimates were concerningly large and that the population size required to sustain current catches is unrealistically high given the species' rarity. Pillans et al. (2021) also reported that the catches reported therein, which were considered underestimates, were likely to pose a serious threat to largetooth sawfish populations in Australia. Overall, the results indicated that the Australian population of largetooth sawfish could be at very low levels and experiencing levels of mortality that continue to reduce the population size (Pillans et al. 2021).

Wueringer et al. (2023) analysed data from 723 sawfish rostra from the four sawfish species found in Australia. Rostra were from animals caught by fishers in Qld over the past 100 years, 92% of which were captured using commercial gillnets. Species composition of the rostra samples was more diverse before the year 2000 compared to after the year 2000. This result indicated that commercial gillnet fishing and trophy hunting may have decreased species diversity of sawfishes along the east coast of Qld, with a shift towards narrow sawfish (the species with the most productive life history characteristics) and a reduction in the relative abundance of, *inter alia*, largetooth sawfish when compared to narrow sawfish. This change coincided with reductions in estimated mean length and mean age during 1920–2020. Moreover, comparison of rostra from gillnet captures with logbook data corroborated the prevalence of underreporting which was also reported in Pillans et al. (2021) (Wueringer et al. 2023).

Fisheries-independent data

This section considers the results of an analysis of catch-per-unit-effort (CPUE) data for largetooth sawfish. Data were collected during research activities across northern Australia during 2000–2021 (Table 5) (Patterson et al. 2022). These research datasets are not subject to some of the issues that confound fisheries-dependent data, including scarcity/absence of on-water data validation or non-reporting of sawfish interactions.

This dataset included 3852 observations and 598 records of catches of largetooth sawfish. Most river systems were surveyed for short periods, and the surveys were either clustered in time or had intervals of several years between them. Additionally, many rivers had zero or few sawfish caught. Overall, the scarce and patchy nature of the dataset precluded the generation of robust estimates of relative abundance or temporal trends. The Fitzroy River, WA, dataset was an exception to these issues, as it was regularly surveyed over a long period (e.g., see Whitty et al. 2009, Lear et al. 2019, Lear et al. 2020, Lear et al. 2021).

Some data exists on sawfish abundance and distribution that were not available to Patterson et al. (2022). Some of these unavailable data are possibly informative, being from areas not represented or filling important gaps in the time series (e.g., Thorburn et al. 2004; Peverell 2005). These data may have been extremely valuable in providing a record of relative abundance trends outside of the Fitzroy River.

Comparison of average CPUE between rivers

Given the sparsity of the dataset, Patterson et al. (2022) provided fitted relative abundances in the various sampling locations to enable a 'space for time' substitution. The Fitzroy River, WA, was treated as a reference point representing a relatively unaffected population. The rationale for the Fitzroy River to be categorised as such was:

- The Fitzroy River is widely recognised as the location of the least impacted population of largetooth sawfish across northern Australia, with lower fishing effort in the region compared to other locations (Table 1; Table 4). As such, it has relatively high abundances of largetooth sawfish compared to other locations (Thorburn et al. 2003; Stevens et al. 2005, Lear et al. 2019; Grant 2022; Espinoza et al. 2022) (Table 6).
- Monitoring of the Fitzroy River since 2002 showed stable and fluctuating recruitment linked with environmental conditions such as flow rates and temperature (Lear et al. 2019, Lear et al. 2020, Lear et al. 2021), indicating that the productivity of the population likely remains high (Espinoza et al. 2022).
- Except for those flowing into the GOC, all river drainages sampled by Feutry et al. (2015), which included the Fitzroy River, appeared to host a genetically distinct population, which likely reflects the philopatric behaviour of females. This means that the Fitzroy River population is unlikely to be impacted substantially by fishing pressure in other geographic areas.
- There are fewer barriers to fish movement in the Fitzroy River compared to other river systems. The Camballin Barrage has been the only major artificial barrier to fish migrations on the main channel of the Fitzroy River (Morgan et al. 2005; Petheram et al. 2018).

- Anecdotal evidence from across northern Australia (for example see the next section) suggests that, prior to the impact of commercial fishing, the abundances of largetooth sawfish in the other rivers investigated in Patterson et al. (2022) were comparable to abundance in the Fitzroy River (Kyne et al. 2021b; Espinoza et al. 2021; Patterson et al. 2022).

Table 4: Total annual fishing effort (number of days fished) in commercial fisheries interacting with largetooth sawfish. Data were collated by Pillans et al. (2021). Blank cells indicate where data were not included (for example for the Qld East Coast Inshore Finfish Fishery and WA Prawn Trawl Fishery).

	Year																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Northern Prawn Trawl Fishery							6983	4829	7963	7984	8044	7583	7690	7842	8145	8233	7880	7880
QLD Demersal Fish Trawl Fishery					266	191	352	386	359	389	289	218	7	0	2	60		
Qld Gulf of Carpentaria Inshore Fishery	23712	25591	25395	30978	31215	25832	24672	24419	25837	23036	21216	20808	21345	20507	18189	19265	18945	13923
NT Barramundi Fishery			3117	3435	2977	3447	3704	3499	3073	2672	2885	2855	2647	2090	1848	1873	2390	
NT Demersal Fish Trawl Fishery			414	228	158	184	281	297	344	505	321	562	1122	1212	1125	1145	1264	
NT Offshore Net and Line Fishery			1801	1538	1176	899	729	780	941	820	808	891	717	502	643	437	607	
WA Fish Trawl Fishery					953	886	914	841	831	713	659	545						
WA Kimberley Gillnet Fishery					899	788	681	612	827	803	935	598	521	630	433	385	529	444

Generalised Linear Mixed Models (GLMM) were used to compare average gillnet CPUE among 33 sampling locations (most of which were rivers). To partly address the confounding effects of (1) river-specific differences in the availability of upstream habitat, (2) natural or anthropogenic barriers to movement, and (3) operational differences between research projects (e.g., tagging studies versus standardised abundance surveys), the GLMM models allowed for variability between rivers to be modelled as a random effect. A second set of models included temporal factors (month and years-since-2000). However, Patterson et al. (2022) concluded that there were insufficient data in most locations to develop reliable standardised relative abundance series using GLMM and therefore those models are not considered in the present listing assessment.

Nearly all other rivers had far lower predicted catch rates compared to the Fitzroy River (Table 5). Sixty-one percent of the rivers were predicted to have zero catches or catches ≤ 0.5% of those in the Fitzroy River, despite some having extensive survey effort. This finding is consistent with very severe declines (> 80%) in largetooth sawfish populations throughout much of the species' Australian range. It is possible that the 17 locations with predicted catch rates of zero (Table 5) do not have extant sawfish populations (Patterson et al. 2022), and there is no evidence to suggest that these rivers only ever supported small or transient populations of the species in the past.

Of the locations with predicted non-zero relative abundance, the Daly, Keep, and the Ord Rivers had abundances that were 50–85% of those in the Fitzroy River (Table 5). Seven rivers had abundances that were 10–50% of those in the Fitzroy River. The obvious outlier in the predictions was the Adelaide River, for which relative abundance was eight times that of the Fitzroy River. However, the confidence intervals on this prediction were also the widest. The high relative catch rates in the Adelaide River are unlikely to represent relative abundance in that location, in part due to (1) the short temporal coverage of survey data and (2) targeted sampling was undertaken there to capture animals for tagging studies (Buckley et al. 2020), rather than standardised surveys of abundance. Predicted relative abundance in the South Alligator River was also higher than in the Fitzroy River. Patterson et al. (2022) noted that unexpectantly high predicted catch rates in the Adelaide and South Alligator Rivers may have been influenced by the stochastic nature of sampling, rarity of largetooth sawfish, the potential for hyper-stability, and the effect of riverine flow on recruitment. The present listing assessment therefore retains its *a priori* hypothesis that the Fitzroy River is home to relatively high abundance of the species.

Excluding the Adelaide River, predicted catch rates in the other 13 rivers with non-zero predicted catches were, on average, 38% (range = 0.5–144%) of those in the Fitzroy River, potentially indicating an overall population size reduction of 62% across those 13 rivers (on average, within the bounds of the Endangered category). Excluding the Adelaide and South Alligator Rivers, predicted catch rates in the remaining 12 rivers with non-zero predicted catches were, on average, 30% (range = 0.5–85%) of those in the Fitzroy River; potentially indicating an overall population size reduction of 70% across those 12 rivers (on average, within the bounds of the Endangered category). The Committee acknowledges that averaging these space-for-time-derived estimates of population size change in this way relies on numerous problematic assumptions including (1) the geographic sizes and densities of the sawfish populations are equal across modelled areas, and (2) relative depletions are homogenous throughout the modelled areas. Although the models used data from years 2000–2021, the

depletions are suspected to have occurred since the commencement of gillnet fishing in the NT and Qld (~1960s–1970s) and therefore occurred within the past three generations.

Table 5 Average catch-per-unit-effort (CPUE; number of largetooth sawfish per 100 m net day) in each sampling location (Patterson et al. 2022). The table also shows the proportion of the CPUE in each location relative to the Fitzroy River, Western Australia. CPUE = catch-per-unit-effort, i.e., the number of largetooth sawfish per 100m net day.

Location	Proportion of CPUE in the Fitzroy River
Adelaide River	774.3
South Alligator River	144.3
Fitzroy River (WA)	100
Daly River	84.7
Keep River	69.4
Ord River	54.1
Norman River	38.3
Ducie River	34.4
Roper River	30.1
Mitchell River	24
Victoria River	20.2
Keep River Estuary	19.7
Bynoe River	14.2
Archer River	0.5
WA coastal	0.5
Skardon River	0.5
Flinders River	0
Dunham River	0
Pentecost River	0
Staaten River	0
Sandy Creek	0
Behn River	0
Negri River	0
East Alligator River	0
Wildman River	0
King Sound	0
Daintree River	0
Snake River	0
Nicholson River	0
Wenlock River	0
Port Musgrave	0
Janie River	0
Normanby River	0

Anecdotal information and range contraction

Photographic evidence, especially those gathered from the Qld east coast and Qld GOC, indicate that mature largetooth sawfish were encountered until the early 1960s (Appendix 1). The

species is now rare along the Australian east coast (the area in which human population pressure is greatest) where they have undergone a considerable range contraction (eds Harrison & Dulvy 2014). As one example, anecdotal reports from recreational fishers suggest that the species was once "very common" in the Ross River, Townsville, but had not been recorded since the early 1990s (Stevens et al. 2005). An ongoing campaign to report public sightings of sawfishes, both recent and historic, failed to reveal any sightings of the species along the Qld east coast since the early 1990s, except within Lakefield National Park (B Wueringer unpublished data 2022, cited in Espinoza et al. 2022).

An analysis of sightings compiled for the entire Australian range revealed a 67% decline in EOO (within the bounds of the Endangered category) and 22% decline in AOO between historic (before the year 2000) and recent years (after the year 2000) (K Lear unpublished data 2021, cited in Espinoza et al. 2022). However, this calculation relies on the assumption of extirpations from part of the species' distribution in WA, which is considered unlikely to have occurred given the relatively low intensity of historic and current threats to the species in WA waters.

Queensland Shark Control Program data

There is evidence of large declines in the catch rates of sawfishes in the QSCP nets between the 1970s (years pooled) and 1990s (years pooled) (Figure 6 in Wueringer 2017). Between these time periods, the catch rate of sawfishes (species pooled) declined by 72% in Townsville and 93% in Rockhampton (i.e., within the past three generations). Wueringer (2017) report catch rates as the annual frequencies of sawfish caught (all species pooled) in gillnets, divided by the annual sampling effort. No data on largetooth sawfish specifically could be extracted from the QSCP data as at year 2017 (Wueringer 2017). A variety of gear and operational changes in the QSCP (reviewed by Leigh 2015), including at the net-by-net scale, likely influenced sawfish catches, although the most significant of these (partial removal of nets in the early 1990s) was accounted for by Wueringer (2017) as only gillnet data were evaluated.

Giles et al. (2002) and Stevens et al. (2005) also reported a clear decline in sawfish catches in the QSCP data during 1970–1990 and that effort was relatively constant during that period (N Gribble, Northern Fisheries Centre, personal communication; cited in Stevens et al. 2005). This decline in sawfish catches also coincided with a significant range contraction of largetooth sawfish along the Qld coast (see previous section). Since 1996, no sawfish had been caught in gillnets off Townsville (Wueringer 2017).

Other assessments of the Australian and Indo-West Pacific distribution

The Action Plan for Australian Sharks and Rays 2021 (Kyne et al. 2021b) assessed the largetooth sawfish following the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Committee 2019), and the Guidelines for Application of IUCN Red List Criteria at Regional and National Levels (IUCN Standards and Petitions Committee 2012). Estimates of fishing mortality rates for the species in Australian fisheries were inferred to exceed sustainable levels. Kyne et al. (2021) also note that the northern Australian development agenda may increase cumulative risk from habitat loss and freshwater flow regulation. Based on population depletion and ongoing mortality (albeit potentially at reduced levels given protection and management measures), Kyne et al. (2021) suspected that the Australian population of largetooth sawfish has undergone a reduction of > 80% over the last three generations (66 years in Kyne et al. 2021b) and categorised the species as Critically Endangered in Australian waters. This categorisation was also informed by:

- The extent of historical declines including global population reduction and reduction in extent of occurrence (Dulvy et al. 2016, Kyne et al. 2013a, Yan et al. 2021).
- Ongoing fishing mortality in Australian waters (Field et al. 2008, 2013, Kyne et al. 2013a, Wueringer 2017, Zhou & Griffiths 2008).
- Presumed high natural mortality (Buckley et al. 2020).
- Increased exposure to cumulative threats including water resource development (Lear et al. 2019).
- Potential impacts on the Australian population of largetooth from heavy fishing pressure outside of Australian waters (Dulvy et al. 2016, Kyne et al. 2013a, Yan et al. 2021).

As part of the 2022 reassessment of the species on the IUCN Red List of Threatened Species, Espinoza et al. (2022) also reported that, across its entire Australian range, the largetooth sawfish is suspected to have undergone a > 80% reduction over the past three generation lengths (68 years in Espinoza et al. 2022). This conclusion was based on:

- Declines in catches of sawfishes in the Qld Shark Control Program (Wueringer 2017).
- Range contraction along the eastern coast of Qld (B Wueringer unpubl data 2022, cited in Espinoza et al. 2022).
- 67% decline in EOO and 22% decline in AOO between historic (before the year 2000) and recent years (after the year 2000) (K Lear unpublished data 2021, cited in Espinoza et al. 2022).
- Ongoing threats including fishing mortality, water resource development and climate change.

The Indo-West Pacific subpopulation of largetooth sawfish was assessed as Overfished (Simpfendorfer et al. 2019) and is listed on Appendix I of CITES and Appendix I and II of The Convention on Migratory Species (CMS).

Global declines and contractions

The sawfishes are considered one of the most threatened fish families (Dulvy et al. 2016). The largetooth sawfish is now 'possibly extinct' in 19 of its 60 former range states, and in 14 range states its presence is currently uncertain due to limited survey effort. Despite protection in at least 17 of its range states, threats are ongoing, and population declines are continuing (Dulvy et al. 2016; reviewed in Espinoza et al. 2022).

Given likely negligible maternal gene flow between south-east Asia and Australia (Phillips et al, 2011; Faria et al, 2013), it is unlikely that the population declines and extirpations reported outside of Australian waters would substantively impact the status and trajectory of the species within its Australian extent. However, evidence of drastic declines and extirpations across the species' global extent demonstrate the high likelihood that threats occurring in Australian waters have caused very severe population declines.

Criterion 1 conclusion

The present listing assessment evaluates all available sources of information and their associated caveats and limitations to make inference about population size reduction in Australian waters under Criterion 1. The above sections outline a broad range of information

that includes different types of evidence regarding population size reductions. In formulating its advice, the Committee considered the following key points:

1) Across a range of model parametrisations, 92% of the estimated declines in the number of mature largetooth sawfish in GOC rivers during years 1970–2020 in Plagányi et al. (2022) were ≥ 80% (Table 4). **Although these models have not been used quantitively under Criterion 1, they do not provide any evidence that the species is not eligible for listing in the Critically Endangered category (Criterion 1 A2bd) within the GOC rivers investigated by Plagányi et al (2022).**

2) PVA models in Grant (2022) do not provide any evidence to suggest that the magnitude of population size reduction across WA, NT and Qld GOC during the past three generations has been < 80% **(within the bounds of the Critically Endangered category Criterion 1 A2bd**).

3) Based on analyses of fisheries dependent data from across northern Australia during 2007–2016, Pillans et al. (2021) reported that the Australian population of largetooth sawfish could be at very low levels and experiencing levels of mortality that continue to reduce the population size.

4) Based on species composition and morphometric data from rostra from largetooth sawfish captured in Qld, Wueringer et al. (2023) reported a reduction in the relative abundance of, *inter alia*, largetooth sawfish compared to narrow sawfish. This change coincided with reductions in mean length and estimated mean age during 1920–2020, which were estimated from largetooth sawfish rostra measurements.

5) Based on a collation of fisheries-independent catch data, 61% of the rivers included in the dataset were predicted to have zero catches or catches ≤ 0.5% of those in the Fitzroy River, WA, despite some having extensive survey effort (Patterson et al. 2022). This finding is consistent with very severe declines in largetooth sawfish populations throughout much of the species' Australian range (**for locations other than Fitzroy Rivier, within the bounds of the Critically Endangered category Criterion 1 A2bd**). Excluding the Adelaide and South Alligator Rivers, predicted catch rates in the remaining 12 rivers with non-zero predicted catches were, on average, 30% (range = 0.5–85%) of those in the Fitzroy River; potentially indicating an overall population size reduction of 70% across those 12 rivers (**for locations other than Fitzroy Rivier, within the bounds of the Endangered category Criterion 1 A2bd**).

6) An analysis of sightings compiled for the entire Australian range revealed a 67% decline in EOO between historic (before the year 2000) and recent years (after the year 2000) (K Lear unpublished data 2021, cited in Espinoza et al. 2022). **This change is within the bounds of the Endangered category (Criterion 1 A2c).**

7) Standardized catch rates of sawfishes in the QSCP during 1962–2016 in Townsville and Rockhampton declined by 72% and 93%, respectively (Wueringer 2017). It is not possible to extrapolate these declines to the national extent of the species. This decline in sawfish catches also coincided with a significant range contraction along the Qld coast (B Wueringer unpublished data 2022, cited in Espinoza et al. 2022).

8) There is strong evidence for substantial global declines and local extinctions of largetooth sawfish, primarily caused by fishing and anthropogenic habitat modifications (eds Harrison

and Dulvy 2014 Yan et al. 2021; Espinoza et al. 2022), which are also the primary threats in Australian waters (Table 1). The species is likely to experience cumulative impacts of multiple threats including various sources of fishing mortality, habitat degradation and climate change.

9) Taken together, life history, demographic and population-structure studies highlight the species' susceptibility to population depletion and that recovery would take many decades (e.g., Feutry et al. 2015; Moreno 2012; reviewed in Kyne et al. 2021a).

Considering the above, the Committee considers that the magnitude of population reduction during the past three generations likely varies substantively across the national extent of the species. Relatively intact populations may persist in WA, e.g., in the Fitzroy River (although it is important to note that water resource development poses a major threat to species, including in WA; Table 2). In contrast, very severe population size reductions (> 80%) and range contractions have likely occurred in Qld waters. Taken together, the Committee's overarching conclusion is that, across its entire Australian distribution, largetooth sawfish is suspected to have undergone a severe reduction in numbers over three generations (66 years for this assessment), from 1957 to 2023. The decline is suspected to be > 70%, and the cause of the reduction (i.e., mortality caused by fisheries) has not ceased. The various sources of evidence outlined in the criteria are based on catch data, which is treated as an index of abundance appropriate to the taxon. Therefore, the species has met the relevant elements of Criterion 1 to make it eligible for listing as Endangered.

Despite the aforementioned knowledge gaps, the Committee considers that uplisting of largetooth sawfish from the Vulnerable category to a higher threat category under the EPBC Act is well supported by data. Uncertainty in the magnitude of population size reduction is not considered to be 'critical uncertainty' (Runge 2011) because it does not impede the identification of recommended conservation actions listed herein. Uplisting to the Endangered category under the EPBC Act, coupled with addressing of the knowledge gaps identified herein, will allow for uncertainty to be resolved, and for future EPBC Act listing assessments for largetooth sawfish to reflect that learning (e.g., using the adaptive management and structured decision-making approaches set out in Runge 2011). As part of this process, the purpose of this conservation advice is to elicit additional information to better understand the species' status. These conclusions should therefore be considered to be tentative at this stage, as they may be changed as a result of responses to this consultation process.

Criterion 2 Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy (*IUCN Criterion B*)

		Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1.	Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2.	Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:				
(a)	Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b)	Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c)	Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Source: IUCN Red List Criteria used to evaluate if taxon is eligible to be included in a IUCN Red List threatened category (Critically Endangered, Endangered or Vulnerable).

Criterion 2 evidence

Not eligible

Extent of occurrence was estimated by Kyne et al. (2021a) to be 2 274 800 km², with 'high reliability' and with the direction and magnitude of any trend remaining unknown (Table 3). Area of occupancy was estimated by Kyne et al. (2021a) to be >2 000 km², with 'low reliability' and with the direction and magnitude of any trend remaining unknown (Table 3). Given the sparsity of survey effort across the species' Australian range, calculating AOO by intersection of a 2 km x 2 km grid with only the spatial coordinates of known occurrences very likely underestimates the area of occupied habitat. Devitt et al. (2015) provide an upper limit for AOO of 895 617 km², based on polygon areas encapsulating suitable habitat rather than using the grid-based set out in the IUCN Red List Guidelines (IUCN Standards and Petitions Committee 2012).

Following assessment of the data the Committee considers that the species/subspecies is not eligible for listing in any category under this criterion as neither the EOO or AOO are likely to be limited. However, the purpose of this conservation advice is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 3 Population size and decline (*IUCN Criterion C*)

	Critically Endangered **Very low**	**Endangered** **Low**	**Vulnerable** **Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate** **25% in 3 years or 1 generation** **(whichever is longer)**	**High rate** **20% in 5 years or 2 generation** **(whichever is longer)**	**Substantial rate** **10% in 10 years or 3 generations** **(whichever is longer)**
C2. An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival[1] based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
(a) (ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b) Extreme fluctuations in the number of mature individuals			

[1] The IUCN Red List Criterion C does not allow for the provision for 'geographic distribution is precarious for its survival'. The corresponding Criterion 3 in the EPBC Regulations currently includes the provision for considering the geographic distribution impact on the survival of the species.

Criterion 3 evidence

Insufficient data to determine eligibility

There is presently insufficient data to estimate current number of mature largetooth sawfish (Pillans et al. 2021; Kyne et al. 2021b), although it is possibly < 10 000 and decreasing (Kyne et al. 2021b). When assuming that fisheries mortality during 2010–2016 was at MSY, the estimated population size required to support estimated catches was 4272 individuals (95% credible interval = 3062–5642 individuals). When assuming that fisheries mortality was at crash point, total abundance was estimated to be 1064 individuals (95% credible interval = 763–1405 individuals). The caveats associated with these estimates, which are related to the extremely limited data that were available, are discussed under Criterion 1.

In the absence of species-specific data that could be used to estimate initial population size for their PVA models, Grant (2022) upscaled estimated population density for smalltooth sawfish (*Pristis pectinata*) (Wiley & Simpfendorfer 2010) to estimate starting population sizes for largetooth sawfish for the Australian metapopulation (excluding eastern Qld). All initial population size estimates for the metapopulation were > 1000 individuals (Grant 2022).

The Committee considers that there is insufficient information to determine the eligibility of the species for listing in any category under this criterion. However, the purpose of this conservation advice is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 4 Number of mature individuals (*IUCN Criterion D*)

	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
D. Number of mature individuals	< 50	< 250	< 1,000
D2.[1] *Only applies to the Vulnerable category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time			D2. Typically: area of occupancy < 20 km² or number of locations ≤ 5

[1] The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a species under D2. As such, a species cannot currently be listed under the EPBC Act under Criterion D2 only. However, assessments may include information relevant to D2. This information will not be considered by the Committee in making its recommendation of the species' eligibility for listing under the EPBC Act, but may assist other jurisdictions to adopt the assessment outcome under the *Common Assessment Method*.

Criterion 4 evidence

Not eligible

The total number of mature individuals within Australian waters is likely > 1000 (Kyne et al. 2021b), which is not considered extremely low, very low or low. Therefore, the species has not been demonstrated to have met this required element of this criterion. However, the purpose of this conservation advice is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 5 Quantitative analysis (*IUCN Criterion E*)

	Critically Endangered **Immediate future**	**Endangered** **Near future**	**Vulnerable** **Medium-term future**
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Source: IUCN Red List Criteria used to evaluate if taxon is eligible to be included in a IUCN Red List threatened category (Critically Endangered, Endangered or Vulnerable).

Criterion 5 evidence

Insufficient data to determine eligibility

Preliminary population viability analyses have been undertaken (Grant 2022). However, these analyses are considered insufficient to demonstrate eligibility under Criterion 5 because (1) it was not possible to include data from across the whole Australian distribution of largetooth sawfish ('metapopulation' models included data from Qld GOC, NT, and WA but not the east coast of Qld), and (2) each of the three cases resulting in terminal extinction of largetooth sawfish included the experimental 'additional crocodile mortality' parameter (Table 6.8 in Grant 2022), which Grant (2022) considers plausible albeit lacking supporting evidence at this time. Hence, reproductive biology and crocodile predation have a high imperative for future research.

Extinction risk varied between scenarios and natality schedules for the metapopulation. Terminal extinction of the metapopulation only occurred in two instances. These were (1) 'Scenario 5 - Additional crocodile mortality' with biennial reproduction with a fixed mean litter size (BLS), and (2) 'Scenario 10 - Additional crocodile mortality & Scenario 6 and 7' with BLS, with extinction probabilities of 95.1% and 73.5% within three generation lengths, respectively. If these results were used for assessment under Criterion 5, this equates to two instances of meeting the threshold for Critically Endangered (probability of extinction ≥ 50%). Other metapopulation extinction probabilities fell below the 10% threshold for Vulnerable. Due to significant historic declines of sawfishes along the Qld east coast (Wueringer 2017), it is assumed that largetooth sawfish remains heavily depleted, and that inclusion of the Qld east coast in the PVA analyses would not have led to more optimistic outcomes for the Australian metapopulation (Grant 2022). The low number of instances of extinction of the metapopulation was due to 0% extinction probability in the NT and WA jurisdictions in most scenarios.

Overall, the Committee considers that there is insufficient information to determine the eligibility of largetooth sawfish for listing in any category under this criterion. However, the purpose of this conservation advice is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Adequacy of survey

The survey effort has been considered adequate and there is sufficient scientific evidence to support the assessment. Key assumptions given the scarcity of the data available on the species are set out under Criterion 1.

Public consultation

Notice of the proposed amendment and a consultation document is made available for public comment for a minimum of 30 business days. Any comments received relevant to the survival of the species/subspecies are considered by the Committee as part of the assessment process.

Listing and Recovery Plan Recommendations

A decision about whether there should be a Recovery Plan for this species has not yet been made. The purpose of this consultation document is to elicit additional information to help inform the decision.

Ownership of intellectual property rights

Creative Commons licence

Cataloguing data

This publication (and any material sourced from it) should be attributed as: Department of Climate Change, Energy, the Environment and Water 2024, Draft Conservation Advice for *Pristis pristis* (largetooth sawfish), Canberra.

This publication will be available at the SPRAT profile for *Pristis pristis* (largetooth sawfish).

Department of Climate Change, Energy, the Environment and Water
GPO Box 3090, Canberra ACT 2601
Telephone 1800 920 528
Web dcceew.gov.au

Acknowledgements

The Threatened Species Scientific Committee and the Department of Climate Change, Energy, the Environment and Water acknowledge the contributions of researchers who contributed data to enable the analyses undertaken by Patterson et al. (2022): Barbara Wueringer (Sharks And Rays Australia), Andrew Storey (Wetland Research & Management), Ross Dwyer (University of Queensland), Peter Kyne (Charles Darwin University), Alastair Harry and Matias Braccini (Western Australia Department of Primary Industries and Regional Development), David Morgan and Karissa Lear (Murdoch University), Richard Pillans and Toby Patterson (Commonwealth Scientific and Industrial Research Organisation) and Colin Simpfendorfer (James Cook University). Fishery Independent data were also provided by the Queensland Department of Agriculture and Fisheries. The Committee would also like to thank others who contributed to or helped enable data collection. These include: Kimberley Gillnet and Barramundi Managed Fishery licence holders; Balanggarra Aboriginal Corporation; Dambimangari Aboriginal Corporation; and Western Australian Department of Water & Environmental Regulation, Western Australian Department of Primary Industries and Regional Development.

Fieldwork data contributed by Sharks And Rays Australia from 2015–2020 was collected under the lead of Dr Barbara Wueringer in collaboration with, and acknowledging the following groups and people: the Kowanyama Aboriginal Land and Sea Rangers under the lead of Fitzroy Lawrence and Anzac Frank, the Mapoon Aboriginal Land and Sea Rangers, the Laura Aboriginal Land and Sea Rangers under the lead of Sue Marsh, Dr Ross Dwyer (School of Biomedical Sciences, the University of Qld), Dr Hamish Campbell (Charles Darwin University), collaborator gill net fishers, and volunteer field assistants. SARA received funding from the Save Our Seas Foundation, the Shark Conservation Fund, Sea World Research and Rescue Foundation Inc, the Office of the Chief Scientist Qld Citizen Science grant, the Minnesota Zoo Foundation, and Rio Tinto Aluminium. Historic images of sawfish were contributed from Sharks And Rays Australia's sawfish sightings database, which is curated by Dr Barbara Wueringer, Ms Veronika Biskis and formerly Jess Hudgins.

Version history table

Document type	Title	Date
Conservation Advice	Approved Conservation Advice for *Pristis pristis* (largetooth sawfish)	11/04/2014

Appendix 1. Historical photographic records

WARNING: Aboriginal and Torres Strait Islander readers are warned that the following pages may contain images of deceased persons.

Table A1.1: Index of historical images (Figures A1.1–A1.8), from the Sharks And Rays Australia (SARA) sawfish sightings submissions database, and provided by Dr Barbara Wueringer (SARA) and Dr Nikki Biskis (SARA and University of the Sunshine Coast).

Year	Location	Latitude (degrees)	Longitude (degrees)	Size (m)	Photograph
1976	Windallion Creek, Burke, Qld GOC	-18.6	138.5	2.0	Figure A1.1
1970s*	Lawn Hill Station, Burke, Qld GOC				Figure A1.2
1950*	Palmer River, north Qld	-16.0	144.1	2.4	Figure A1.3
1965	Cairns, north Qld	-16.7	145.7	5.3	Figure A1.4
1966	Cape Bowling Green, north Qld			5.8	Figure A1.5
1959	Burdekin River, north Qld	-19.7	147.6	5.0	Figure A1.6
1950	Scarborough, southeast Qld	-27.2	153.1	4.3	Figure A1.7
1921	Unknown				Figure A1.8

Approximate or uncertain years are denoted by asterix. GOC = Gulf of Carpentaria. Geographic coordinates are rounded to 1 decimal place.

Figure A1.1: Largetooth sawfish (*Pristis pristis*) captured in Windallion Creek, Burke, Qld in year 1976. Image from the Sharks And Rays Australia (SARA) sawfish sightings submissions database, and provided by Dr Barbara Wueringer (SARA) and Dr Nikki Biskis (SARA and University of the Sunshine Coast).

Figure A1.2: Largetooth sawfish (*Pristis pristis*) captured in Lawn Hill Station, Qld during the 1970s. Image from the Sharks And Rays Australia (SARA) sawfish sightings submissions database, and provided by Dr Barbara Wueringer (SARA) and Dr Nikki Biskis (SARA and University of the Sunshine Coast).

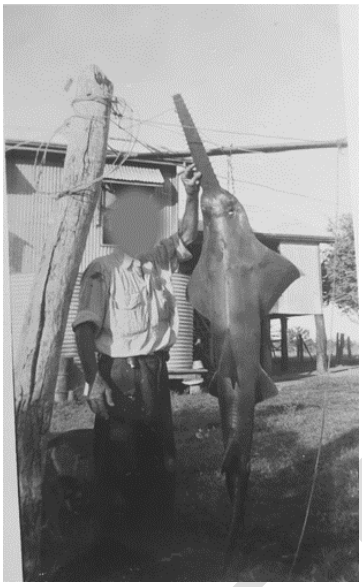


Figure A1.3: Largetooth sawfish (*Pristis pristis*) captured in the Palmer River, Qld around year 1950. Image from the Sharks And Rays Australia (SARA) sawfish sightings submissions database, and provided by Dr Barbara Wueringer (SARA) and Dr Nikki Biskis (SARA and University of the Sunshine Coast).

Figure A1.4: Largetooth sawfish (*Pristis pristis*) captured in Cairns, Qld in year 1965. Image from the Sharks And Rays Australia (SARA) sawfish sightings submissions database, and provided by Dr Barbara Wueringer (SARA) and Dr Nikki Biskis (SARA and University of the Sunshine Coast).

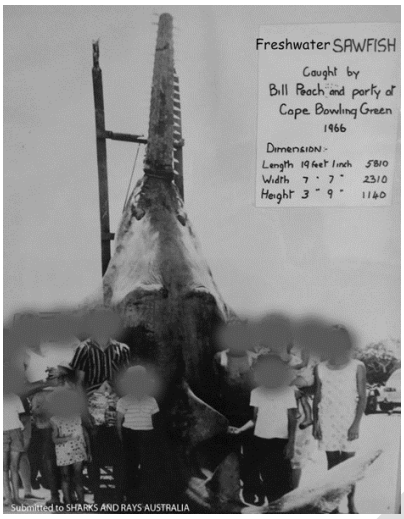


Figure A1.5: Largetooth sawfish (*Pristis pristis*) captured at Cape Bowling Green, Qld in year 1966. Image from the Sharks And Rays Australia (SARA) sawfish sightings submissions database, and provided by Dr Barbara Wueringer (SARA) and Dr Nikki Biskis (SARA and University of the Sunshine Coast).

Figure A1.6: Largetooth sawfish (*Pristis pristis*) captured in the Burdekin River, Qld in year 1959. Image from the Sharks And Rays Australia (SARA) sawfish sightings submissions database, and provided by Dr Barbara Wueringer (SARA) and Dr Nikki Biskis (SARA and University of the Sunshine Coast).

Figure A1.7: Largetooth sawfish (*Pristis pristis*) captured in Scarborough, Qld in year 1950. Image from the Sharks And Rays Australia (SARA) sawfish sightings submissions database, and provided by Dr Barbara Wueringer (SARA) and Dr Nikki Biskis (SARA and University of the Sunshine Coast).

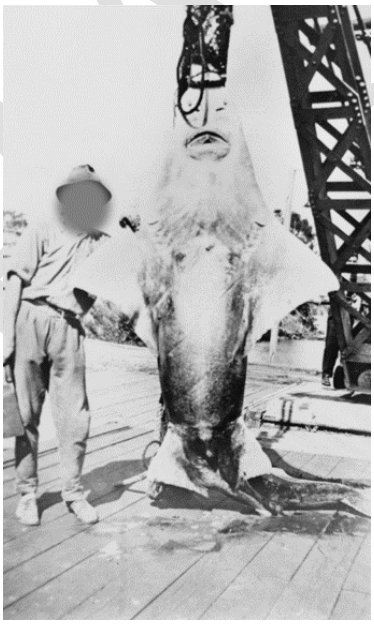


Figure A1.8: Largetooth sawfish (*Pristis pristis*) captured in Australia in year 1921 Location is unknown. Image from the Sharks And Rays Australia (SARA) sawfish sightings submissions database, and provided by Dr Barbara Wueringer (SARA) and Dr Nikki Biskis (SARA and University of the Sunshine Coast).